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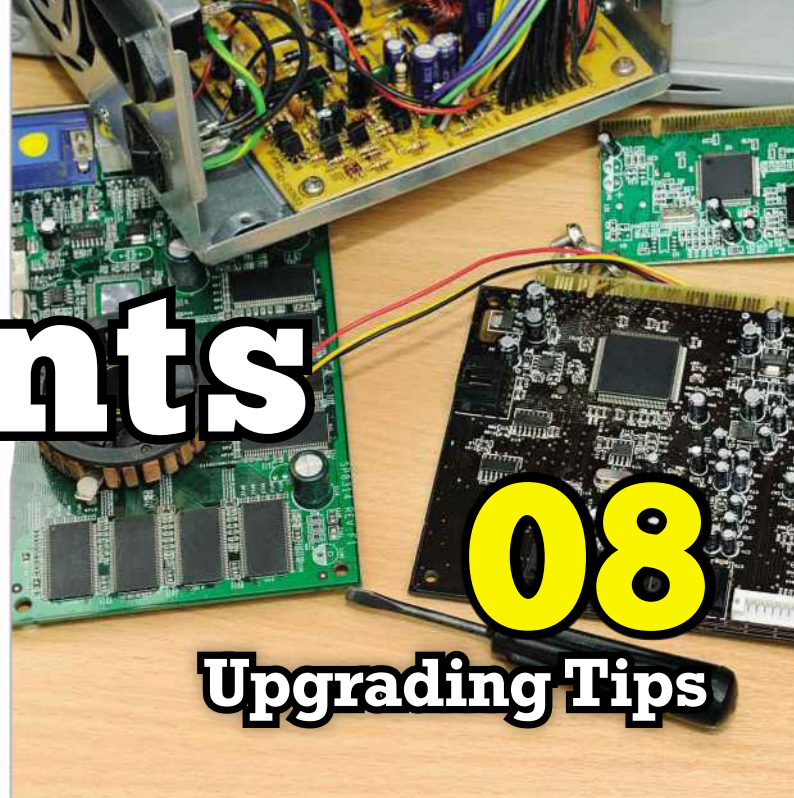
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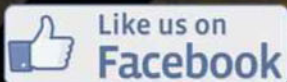
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10 Tips

For Making Smarter Upgrades

James Hunt looks at how to make your upgrades count

Upgrading your system is easy to do if you have a lot of money and no qualms about spending it, but not all of us can afford to take the easy route. Sometimes you have to be smarter about how you upgrade and what you buy. And to help you meet that goal, we've compressed some of our ideas for making smarter upgrades into this list of easy-to-remember tips, tricks and nuggets of advice that'll get you the best system possible whatever your budget.

1

Aim To Buy An Unlocked CPU

Broadly, processors fall into one of two categories. They're either 'locked', which means they run at (roughly) the speed quoted on the box, or they're 'unlocked', which means they can be overclocked with the risks attendant to that. While improperly applied overlocks can stress hardware by heating it up literally to breaking point, a properly measured and

sufficiently cooled overclock can turn your processor into something far better than the one you bought.

For this reason, if you're buying a high-end processor, it's always worth getting an overclockable model and pairing it with a new cooler. OEM coolers are designed to perform at the necessary levels to cool a CPU at its rated speeds, but to overclock you need the extra cooling capacity to ensure stability. Once overclocked, some of Intel's Core i5 CPUs give performance as good as the best Core i7 CPUs, meaning you've essentially bought an extra performance tier for the cost of a new cooler.

Overclocking isn't something we recommend to every user, of course, and you'll have to decide personally what sort of risk you want to take, but the cost of giving yourself the option is so small that it's worth looking out for unlocked CPUs whether you plan to overclock or not. Locked processors cost no more than

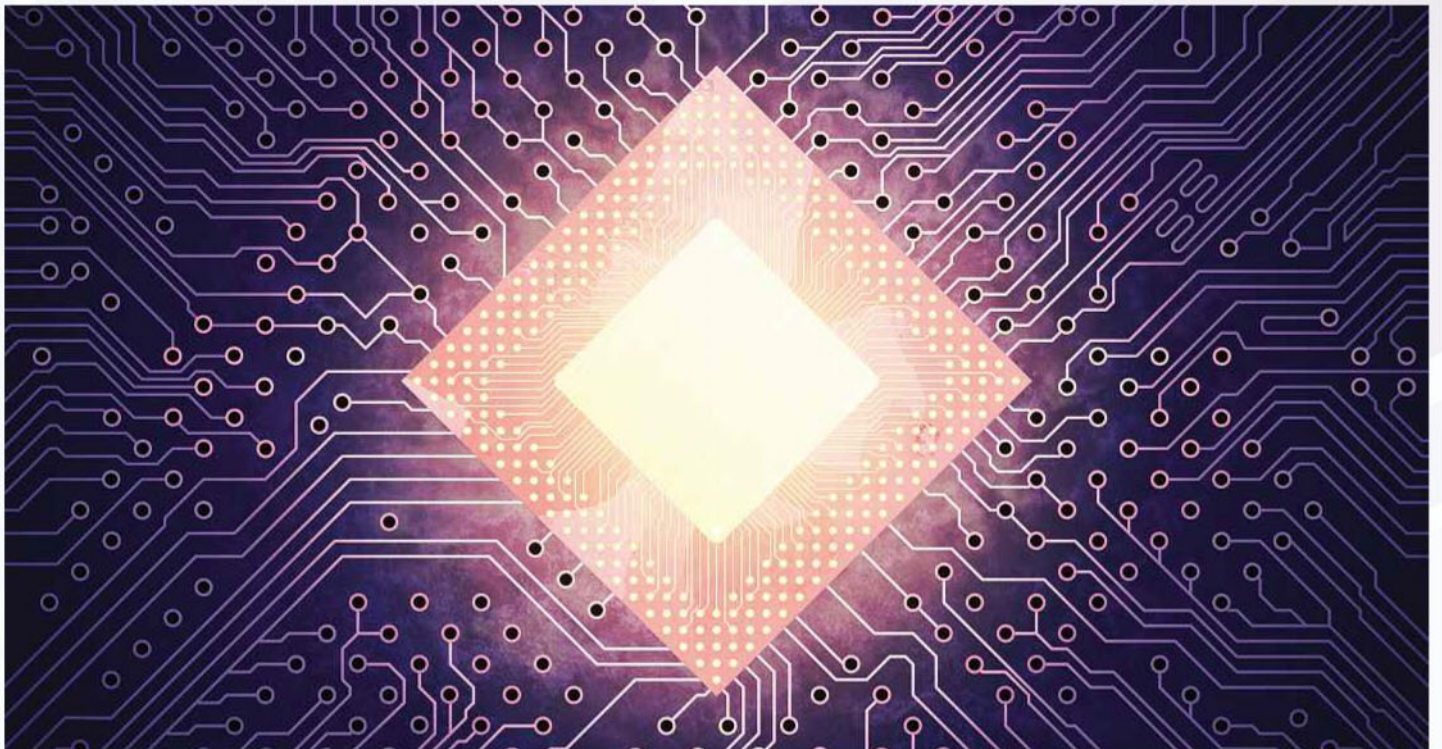
£5-£10 less than their unlocked line-mates, so the saving you make isn't worth the lost potential.

2

Buy RAM For Better Multitasking

Adding memory to your system isn't a sure-fire way to speed it up, but more memory does definitely help in one specific area, and that's multitasking. If you're the sort of person who keeps hundreds of tabs open on your browser or who likes to run ten programs at once, a RAM upgrade is worth pursuing.

Quite simply, the more programs you have open, the more RAM your system needs. If you run out of physical memory, Windows will switch to virtual memory, which can be slow to access – that explains why your hard drive sometimes churns when you switch applications: because it's swapping the programs out of virtual memory and into physical memory.



Additional RAM can help in other areas too – it'll speed up editing audio, video and images, because editing raw media requires a lot of RAM for uncompressed storage, and it can have a small effect on games as well, because textures and models can remain resident in physical memory rather than being loaded from their source media or from virtual memory. But these benefits are ultimately small compared to the effect you get on multi-tasking, and if you're wondering whether more RAM would help, those are the circumstances in which it will.

3

Install Fan Filters

Most people don't think about the temperature inside their PC, and certainly the level of cleanliness rarely gets a look in to most people's general maintenance plans, but they can both have a definite effect on system performance. Hot components perform badly and fail more easily, and when dust builds up on hardware it not only insulates that heat, it also reduces the efficiency of existing cooling measures like fans and heatsinks.

We can therefore say that adding fan and case vent filters to your system is probably a smart upgrade to make for your system, and if you've ever had a look at the thick carpet of dust inside even relatively young PCs, you'll understand why. They're cheap to buy, easy to install and remove, and the filters are washable for easy cleaning. You may need to do

a little customisation so they fit properly inside your system, but it's an upgrade worth making for how they transform the task of keeping your computer clean into such an easy thing to do.

4

Invest In Tool-Free Fittings

The ability to use tools is undoubtedly one of the evolutionary leaps that made humanity what it is. Unfortunately, computers aren't really designed to accommodate long, thin screwdrivers. No matter how versatile your system, there always seems to be one screw positioned in such a way that no screwdriver on the planet can actually get to it.

The reality is that if your computer is difficult to disassemble, it reduces the likelihood you'll want to upgrade, and it makes it more likely that you'll cause damage when you do take it apart. A slip with the screwdriver can send even the most hardy system straight to its grave, and a dropped or missing screw can create havoc by allowing loose components to rattle or, worse, slip out of place entirely.

To avoid these problems, don't use the screws that came with your system; buy a set of thumbscrews instead. These aren't the medieval torture device of the same name, but normal screws with large, easily gripped tops that can be taken out and put back in using no more tools than your thumb and index finger (although they do have slots for screwdrivers too). They massively speed up a build and any future

upgrades, so what they cost in money, they repay in long-term stress reduction.

5

Avoid Hybrid Drives

Pairing an HDD with an SSD is a good idea if you want to maximise the speed and capacity of your storage, but contrary to what the logic suggests, actual hybrid drives (which incorporate a mechanical and SSD drive within one unit) rarely prove anything other than awful.

The intention is to combine the high storage capacity of mechanical hard drives with the fast access speeds of solid-state storage. The reality is that they combine the low storage capacity of solid-state storage with the slow access speeds of mechanical hard drives. Hybrid drives still operate more slowly (on average) than pure SSDs, and the limited capacity of the SSD portion can often frustrate users, requiring more micro-management than is strictly necessary.

There's no question that they're faster than standard mechanical hard drives, as well as being cheaper than SSDs, with the ability to store more than an SSD, but hybridisation augments the failings of both technologies as much as the successes!

6

Think About Your Upgrade Path

When you build or upgrade a system, it's always worth making a note of the options your purchases will give you in the future. In

particular, when you buy a motherboard you really have to commit to that one: it's hard to upgrade a motherboard without completely dismantling a system and replacing several major components, so if you're building a system designed for long-term use, you want to make sure it can handle not just everything you want to put in it now, but everything you might want to put in it later.

Take care that you don't make short-term savings by omitting cheap features that might come in useful further down the line. It's possible to buy discount motherboards with only two RAM banks or a small number of expansion slots, but such choices are almost guaranteed to cause trouble later on when you come to upgrade. Support for SLI or CrossFireX is the one area where you can compromise, because unless you're a hard-core gamer, it's exceptionally rare you'll own the two graphics cards necessary to make use of it! Virtually every other feature is worth having. Keep your options open and you won't have buyer's remorse later on.

7

Don't Automatically Buy Current Generation

For certain types of hardware, buying older models that have lost their place on the cutting edge (but are still close to it) will allow you to

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get performance that's almost as good as the current generation, but comes at a substantially lower cost.

In the case of Intel's CPUs, every alternate generation is a die-shrink of the previous one, which means that they use less power and generate less heat but broadly cost a lot more without being substantially faster. They are a little faster, admittedly, but the difference in speed is a single-figure percentage value, compared to the double-figure percentage difference in the price. That makes the previous generation chip a better value purchase.

Obviously, there are circumstances where this doesn't apply, and that's normally when a hardware iteration is evolutionary in nature. Back in 2011, Sandy Bridge's debut was substantially beyond anything else on the market, which made it the best performing *and* best value chip on the market. Similarly, AMD APUs are better value than their CPUs because of their superior range of capabilities and better graphics

technology, even if the processing speeds aren't much different.

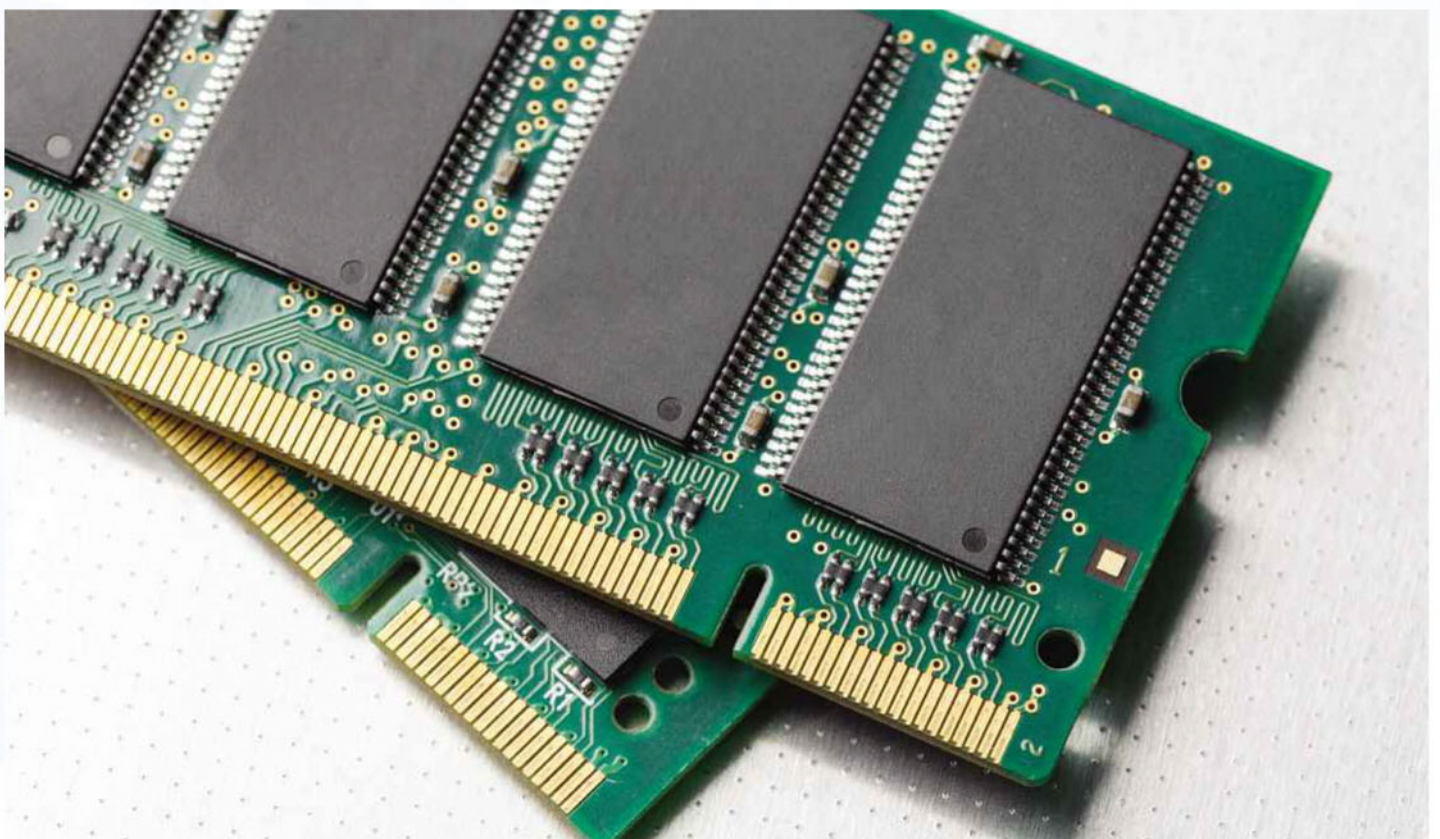
The lesson is that you shouldn't automatically think that newer is better. Sometimes it is, but often it isn't!

8

Buy RAM Sticks In Pairs

When you come to buy RAM, you'll probably have a number in your head about how much you want. For argument's sake, we'll assume it's 8GB. You now have a choice: do you want to buy one 8GB stick, two 4GB sticks or even four 2GB sticks? You might not even be aware that whatever you choose can have a very real knock-on effect on the performance of your system.

Although it might be cheaper to buy one stick of 8GB RAM instead of two 4GB sticks, it's actually a better idea to make the latter choice. Buying two sticks of RAM instead of one allows them to be used in 'dual channel' paired mode, which effectively treats two sticks of RAM as if they were one. Because





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they're not, though, the access times are faster and your system performance is therefore better.

Most companies produce retail kits that contain a pair of 'matched' RAM sticks, meaning they've been checked over and are guaranteed to run at exactly the same speed. This optimises performance on a micro level. If you buy RAM sticks separately, you could end up with slightly mismatched sticks, which give detrimental performance.

And while it's possible to go another step further and buy four sticks instead of two, it's not necessarily a good idea – you can't run in 'quad channel' mode pairing four sticks together, so you don't get any major speed benefits. And what it does mean is that your motherboard's memory banks will be full, so if you buy any new RAM further down the line you'll have to chuck some out!

9

Don't Ignore The Case

It's hardly the most exciting part of any PC build, but a good case is crucial to creating a good system. And in particular, you need to make sure you're buying the right case for your system.

Unless you're building a specialist system such as an HTPC or server, you'll probably want a standard ATX mid-tower case. This will give you space for a couple of optical drives, a couple of hard disks or SSDs, space for around five expansion cards and a couple of fans. Full towers are more expensive and allow for more of each, but they also tend to be unnecessarily large for most home users.

Performance systems will be further improved by a case that has extra cooling features like fans and vents, and more space inside for air to circulate. Don't worry about a case window or interior lighting – they're purely cosmetic features – but if you're planning to modify your system a lot, you may want to look for tool-free fittings to make adding and removing components much easier!

10

Buy Open-Box Items

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Indeed, ex-display and open box goods might even be unused. Sometimes, they've been opened to show an in-store customer what they're buying. Other times they've been opened and sent back to the retailer by a customer who realised they bought the wrong thing. True, sometimes they've been running non-stop for months on a display system or were returned because a previous customer found a fault, but don't let that worry you: open box goods are sold under the same terms as anything new. If they don't work, you can still return them. If they do, you just saved yourself a huge packet.

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Get The Most For Your Money

Components

The road to good value starts here

When you're putting together a system, there's a trick to finding the best bargains. Shopping around can save you a little bit of money – maybe a quid here, two quid there – but if you want to get the most power for your pound, the trick is simple: side-step the hardware arms race of getting your hands on the latest, fastest components and instead look for products that are in the pricing sweet spot. The place where the trade-off between age, price and power reaches its optimum point.

Hardware that isn't brand new but is instead towards the middle of its life-cycle is often heavily discounted, while retaining competitive performance, so you save a lot of money and get a system that's still above average. Of course, this doesn't apply to every type of product. Sometimes the best value products genuinely are the newest or the most expensive. So to help you find the best bargains for your system, we've combed the market and compiled the information into this – our guide to buying PC components that have hit the pricing sweet spot.

CPUs

Although AMD chips are good for building low-end systems thanks to their high-quality integrated GPUs, few would deny that it's Intel that triumphs on price-to-performance ranges. Since it's tough to evaluate both CPU and GPU performance, you'll have to trust us when we say that if you're looking to get the best performance out of your money, it's an Intel chip you need.

Intel CPUs are best suited for use in mid-level to high-end systems, which need great single-threaded performance, so things like HD media playback, gaming and image processing. While Pentium and Celeron chips are less powerful and therefore cheaper, they're also quite expensive in performance terms. If money is a huge worry, your best option would be to buy a Core i3 chip, which is significantly more powerful than Pentiums and Celerons (but better value), or a Kaveri-based AMD APU, which will at least give you the ability to save money on a graphics card.

But if you're assembling a system from scratch and looking for the best value

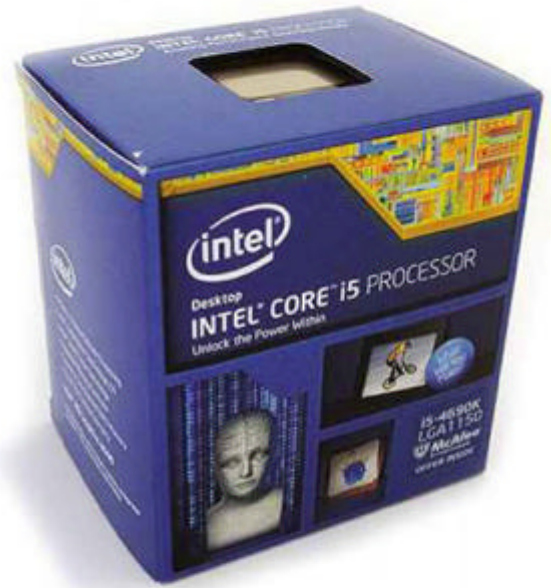
performance, stick with Intel. It makes most sense to go for the most recent generation of chips, because CPUs don't lose a lot of value as they age. Having an older chip and motherboard is only going to limit your potential for making future upgrades. For Intel, that currently means buying a Haswell chip and ideally one from the Devil's Canyon refresh.

It's also worth looking for a K-series chip. The main advantage is that they can be overclocked, which means you can potentially get significantly better value out of your purchase. If that's what you're looking for, then it's a good idea to go for the latest, fastest chip in the Core i5 line regardless of whether you want faster, because they already run as well as a Core i7 chip even before they're overclocked. In any case, Core i7 chips cost a significant premium, so the performance you get per pound starts to drop sharply once you get out of the Core i5 line.

That said, if you're definitely not planning to overclock your chip, you can save around a tenner by going for the locked version (it'll have the same model number but without the K suffix), and it's probably worth doing that; the only reason to buy a K-series chip is their overclocking potential, and if you know you won't exploit it, don't waste your money.

Recommended Intel CPU:

If you're buying a new Intel chip, there's only one real choice: the quad-core, Haswell/Devil's Canyon-based Intel Core i5-4690K, which has a 3.5GHz base rate that's 100MHz faster than Intel's previous best i5 (the 4670K). This translates to better single-core performance and slightly better value than the older chip, and both are way ahead of the next cheapest, the i5-4460. The on-board Intel HD Graphics 4600 graphics are relatively weak, so if you're buying it for a gaming or media-editing system, you'll want a proper graphics card in there, but it's far from mandatory. All things said, you'll pay about £185, but the cheapest Haswell i7 is a full £50 more despite being no better for the majority of home usage.



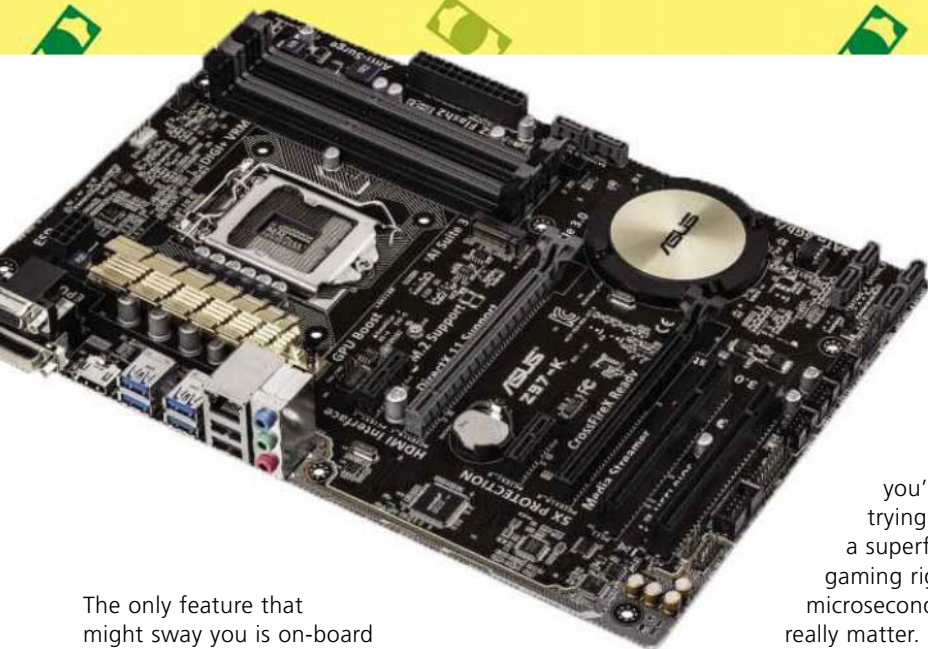
Motherboard

When it comes to motherboards, there's a wealth of choice available. For that reason, we should work backwards for the choice of CPU. We've established that the best value chips are Haswell, because they give you the best performance and the best upgrade path, and we've also established that the best value Haswell chip is the one you can overclock. Therefore, you need a Haswell motherboard that can be overclocked. And that all narrows down to two choices of motherboard chipset: the Z87 or the newer Z97, both of which support full CPU, GPU and RAM overclocking.

As its designation suggests, the Z97 is an upgrade to the Z87. Although Devil's Canyon chips are only slightly better than original Haswell chips, the newer motherboard platform has one significant difference: it'll support Broadwell chips when they come to market. That's crucial for keeping your upgrade path intact, and that's why we have to recommend the Z97 over the Z87: for a small premium, you get a year's extra usage.

Additional features of the Z97 include support for SATA Express and M.2 SSDs, both of which will greatly increase maximum throughput for SSDs, so it's not all about the chip you put into it. Once you've selected the chipset, you could go crazy trying to pick the right board that uses it, but the reality is that they're all broadly the same. Some variation in features is inevitable between manufacturers, but as long as you have a decent number of expansion slots and USB ports, that'll be most users catered for.

“ If you're definitely not planning to overclock your chip, you can save around a tenner by going for the locked version ”



The only feature that might sway you is on-board Bluetooth connectivity. Even Wireless AC is rare enough that you'll probably want to buy a separate card rather than pay for it on board.

As a final note, if you don't plan to overclock, then you can save money by going for an H97 board, which has broadly the same features but doesn't support overclocking. You can save about £20 but, of course, if you have a chip that can be overclocked, the cost in performance terms is potentially much higher.

Recommended Motherboard:

We can't, in good conscience, recommend a motherboard for a mid-level PC that costs more than £100, so while Asus's Z97-K board doesn't showcase all the chipset's features, it is the one we'd go for. The biggest omission is that it's not SLI compatible because the secondary PCI-E slot is only 4x speed. To get support for SLI you'll need to pay another £50-£75 at least, though, and that's for a feature that the majority of PC users will never use. Unlike cheaper boards, this one has four RAM slots, and by contrast that is worth paying for in case you ever want to add more memory without replacing your existing set. There's also no wi-fi, but when you can buy a wireless card for £20 or less, it's not worth worrying about; it's almost always more expensive to get a motherboard with on-board wi-fi than it is to buy separately.

RAM

In many ways, choosing the best RAM involves a lot of splitting hairs. As long as you have the capacity (you want at least 8GB), then most of the time you're measuring performance improvements in microseconds, and let's face it, when

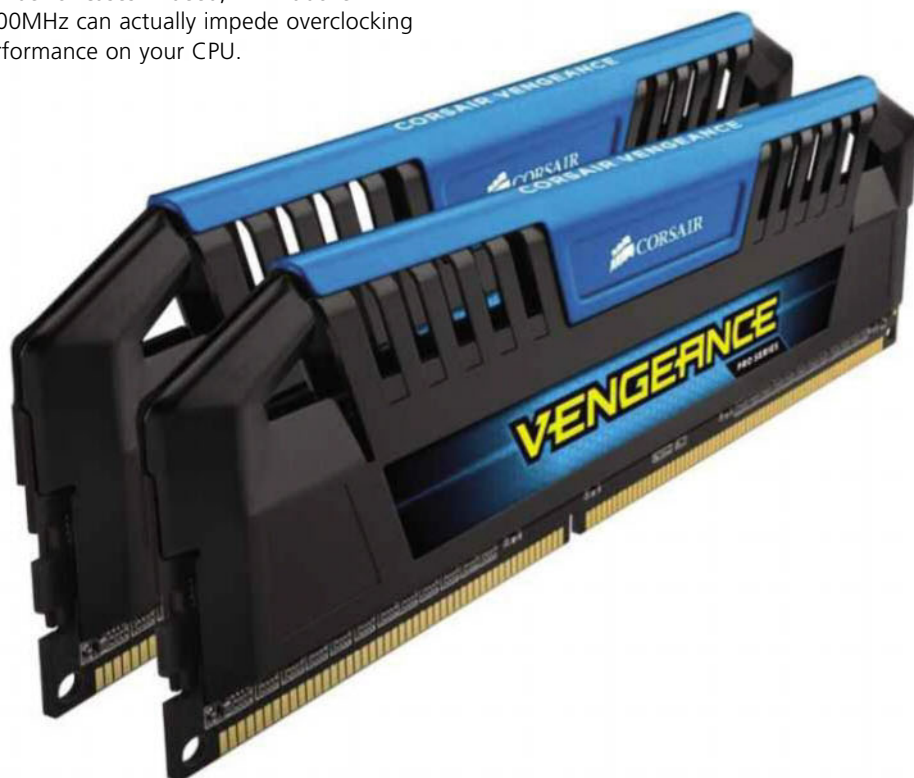
you're not trying to build a superfast gaming rig, those microseconds don't really matter.

There are some recommendations worth making, though. You should, for example, look for a pair of modules rather than a single one. For reasons too technically involved to be worth explaining here, the performance is better on a dual-module pairings. For Intel Core i5 CPUs, you should buy modules clocked at speeds of at least 1600MHz, although 1866MHz is worth buying if you have the necessary support from both your motherboard and chip. Faster RAM isn't completely pointless, but it's also expensive and again doesn't come into play except in a very limited number of cases. Indeed, RAM above 2000MHz can actually impede overclocking performance on your CPU.

Other than those factors, your main interest when looking for RAM is the quality of the memory itself. As long as you buy branded RAM, you shouldn't have a problem, and if you're planning to overclock, then get something with a decent heat-spreader, just to minimise any risks. It's rare that RAM gets so hot that it's negatively affected by the temperature, but a heat spreader will ensure the temperature is always low and minimise wear on the components.

Recommended RAM:

If you're running a Haswell system, you should look for RAM that runs at 1.5V. Modules that require 1.65V will still work, but you may have to manually change the voltage settings in your system's BIOS to get optimum performance. For no particular reason other than they look quite cool and are made by a company with a good reputation, we've picked the Corsair Vengeance 8GB kit, which costs £60 – though, £10 either way will get you RAM just as good from any other manufacturer. Unless you have specialist needs and are willing to pay specialist prices, this kit is going to meet all your needs and then some



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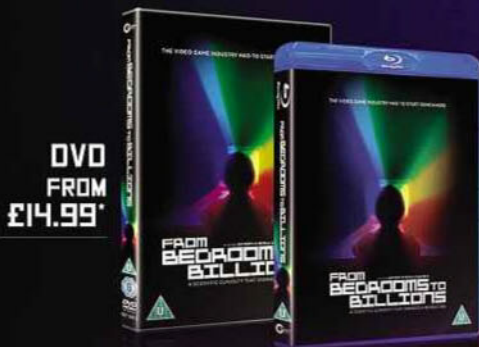
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drive, but the drive itself is a third cheaper, so ultimately, the economy works out.

Recommend Model:

There's very little variation in the mechanical drive market at this point, but Seagate's Barracuda drives are hugely reliable, and with 2TB of space to fill, the drive will probably wear out before you run out of storage – unless you're a movie-lover who can't stand Netflix. If that's the case, £20 extra will get you another terabyte of storage on top of that, but as we've just explained, we think it makes more sense to hang onto the money.

You could equally buy a 2TB drive from Toshiba or Western Digital, though. As long as it's 7200rpm and has a SATA-3 connection, it's all good.

Solid-state Drive

If you do want an SSD in your new system or want to add one to an existing PC, we can't really blame you. SSDs are the fastest storage method you can buy, and it seems like there's a new, more efficient, more capacious model out every other month or so.

And while SSDs are expensive, they do add extra value beyond storage – by removing the bottlenecks caused by mechanical drive access, they speed up your system on multiple levels. It's undeniably problematic for mid-range buyers that the prices are sky-high, but that is improving, and if you want to get the most out of your money, then that doesn't necessarily mean getting the best capacity; it also means getting the upgrades faster storage brings with it.

As with hard drives, the most expensive SSDs in terms of gigabytes per pound are actually at the smaller end of the spectrum. The cheapest 32GB drives cost around £30 – essentially £1 per GB – while even 64GB drives cost as much as 50p per GB. The current

sweet spot for SSDs is around 256GB, which average around 28p per GB, so start your search there. 480GB drives cost about 31p per GB so they're also quite good value if you want the extra capacity, but 960GB drives all creep back over the 40p per GB line, so avoid those.

Feature-wise, there's really nothing else to look for. Make sure you don't buy enterprise hardware, which may be optimised for multi-user reads and have wildly asymmetric speeds, and don't be fooled by the speeds quoted on different units, since they bear little resemblance to practical use.

Recommended SSD: It has to be the Samsung 850 EVO, the 250GB model of which costs just £85. Samsung's SSDs have consistently impressed everyone, and the 850 EVO is no exception. It's one of the company's latest models and runs on new 3D V-NAND flash memory, which is super-fast and low power. It also benefits from Samsung's proprietary multi-core MGX SSD controller, and a longer than average five-year warranty. It might not compete with mechanical drives on capacity, but 250GB is more than enough to comfortably run a PC on. If you want an SSD, this is the model to go for. [mm](#)

Hard Drive (Mechanical)

The type of storage you go for in a system currently depends heavily on whether you're aiming for capacity or performance. That said, no matter how fast SSDs are, usable sized models are still incredibly expensive, even at the low end of the market.

With that in mind, we think mechanical hard drives are still the first port of call for anyone building the best value system. In theory, to find the hard drive that gets you the best deal, all you have to do is divide capacity by price to see which gives you the most gigabytes per pound, then buy that one.

The problem with doing this is that the 'sweet spot' for hard drives is currently somewhere around the 3TB mark, which means you get about 35GB for every pound you spend. This compares favourably to 4TB drives (34GB per pound), 2TB drives (33GB per pound) and 1TB drives (23GB per pound). But however you slice it, 3TB is a ludicrously huge amount of space to put in a general use PC. It's fine for NAS enclosures or media servers, but for home use it's pretty excessive.

The economics are clear: the bigger the drive you get, the better value each one is until you get beyond 3TB. But is buying space you don't need a way to get good value? A 1TB drive is probably enough for most people, but it's also quite bad value. We suggest you split the difference and buy a 2TB drive. That way, you can keep the amount of money you spend quite low while making sure you get a good deal on it. The capacity on a 2TB drive is only about 5% more expensive than a 3TB



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Get The Most For Your Money

Peripherals

Why spend more than you need to?

Even once you've decided what goes into your new system, you're only halfway done. Next, you have to decide what goes on the outside. Choosing the right peripherals can be tricky. Unlike components, you can't rely on a sweet spot between pricing and performance, because there's very rarely a generational component to look out for. Monitors, speakers and input devices come out at all times of the year, and they either support the features you want or they don't.

For that reason, the secret to getting the most for your money is figuring out the features you need and only paying for those. And that's what we're going to help you with.

Monitors

There are a few different classes of monitor you might want to look at, all of which use different technologies – though picking the right one is fairly simple.

Sub-HD monitors have resolutions lower than 1920 x 1080. Typically they'll have a screen size of 20 inches (or smaller). Although they're generally cheaper than the average HD monitor, you only make a saving of around £10-£20 compared to the cheapest HD monitors. What you get instead is a greater feature set for your money, such as built-in speakers or a better-quality panel. It's worth noting that you probably won't get an HDMI port, however – just VGA and/or DVI. Screens of this kind are best aimed at office use, where HD visuals aren't normally required, though they also work as cheap monitor solutions for underpowered systems or laptops.

HD monitors are the most common type. They have a resolution of 1920 x 1080 and a screen size normally from 20 inches to 27 inches, though the higher-end ones are quite expensive and look a little worse than smaller monitors due to their larger pixels. The cheapest HD monitors are around £75, but these are often incredibly basic models which, in some cases, lack the HDMI input that makes them most useful.

HD monitors are of particular interest for all-round users who might find themselves playing games and/or watching HD video, such as Blu-ray discs or HD movies. For entertainment purposes, it's normally a better idea to pay around £150 for a monitor. It's not such a huge deal for a screen to have integrated speakers (because even a cheap pair of dedicated speakers will outperform integrated ones), but HDMI inputs, a good-quality panel and adjustable positioning are important for giving your system a full range of usability.



“ The performance and features found in speakers scales relatively well with their pricing ”

Finally, beyond HD screens you'll find premium monitors. They might be HD with a 120Hz (passive 3D) refresh rate, have a 4K resolution, active-panel 3D support or be larger than 27 inches, but in all cases they're beyond the reach of all but the most cash-happy users. High-end gamers, home cinema users and visual designers might want screens in this class, but specialist use commands specialist pricing. There's good hardware to be found, but it's emphatically not good value.

Within these brackets you'll also have to choose between two different types of panel: TN and IPS. The general rule is that if a monitor doesn't explicitly state a panel type, it's probably TN, which is low quality but cheaper. IPS panels have better colour reproduction, higher contrast and bigger viewing angles, so unless you're specifically trying to minimise cost, that's the type to look for.

Recommended Monitor: Ideally you want an HD monitor with an IPS panel, HDMI port and relatively large screen size. And for that reason, the Asus VS248H is our choice.

At £150 it's not too expensive for a 24" screen, but it has all the features we want and it supports sound over HDMI thanks to a 3.5mm audio-out jack. It's always hard to pin down a monitor given the wide range of users' needs, but we're confident that this one will satisfy most people.

Speakers

The performance and features found in speakers scales relatively well with their pricing, which makes picking good value ones quite simple, especially if you're a relatively basic user.

At the extreme low-end you'll find unpowered stereo speakers. These are best ignored – their output is only a couple of watts, and bass will be non-existent. Realistically they're only useful as portable speakers for phones and MP3 players, and even then they're probably no better than whatever the device features internally. You don't pay a lot for them – maybe just a few pounds – but for the performance they give, you might as well not spend the money at all.

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speakers that surpasses anything even laptops and monitors contain. A simple set of powered stereo speakers might set you back no less than £15, but they'll have high enough volume and quality that they'll prove adequate for all desktop use, be it playing games, watching videos or listening to music.

More sophisticated systems are only necessary if you're a high-end gamer or entertainment enthusiast. If your computer is your main music system (unlikely in most homes), then a 2.1 speaker system with a sub-woofer might make sense, but 5.1 surround systems are reserved for people with HTPCs and sophisticated gaming systems, where immersion is the primary quality being sought.

Most speaker systems only have a limited feature set regardless of the price. The cheapest might omit a separate power button or headphone port, but most have both of those and a volume dial too. Individual bass and treble control may be available on mid-range models, and optical connections are only present on the most expensive speakers, though it's of little interest to casual users.

The only thing to actively avoid at the low end is speakers that use a USB connection instead of (rather than in addition to) a 3.5mm connector. USB does have the added benefit of maintaining a digital interface, which reduces interference, but without the 3.5mm connector their compatibility with other devices makes them undesirable.

Recommended Speakers: The Logitech Z150 2.0 system costs less than £20, but it gives more features than most users will ever need. As well as a volume/power dial, a headphone jack and 6W-combined output, they feature not one but two 3.5mm inputs, meaning it's easy to connect up your phone or tablet as well as your main PC and easily switch between them – a feature no other

speakers at this price really offer. Unless you're building a high-end, entertainment-focused PC, the Logitech Z150 system will meet your needs (and more) for a very reasonable price.

Mouse

Buying the right mouse is often more trouble than it's worth, especially when the options seem to fall into one of two camps: cheap and nasty or good but hugely overpriced. But that doesn't mean it's impossible to find the right balance – just that it's uncommonly difficult given the simplicity of the hardware itself.

One thing to pay attention to is the connection type. Wired connections can sometimes seem outdated, but their low-latency on input makes them a popular choice for gamers, and thus many high-end examples are wired. Wired mice also don't need batteries, and while that saves on the irritation of having to replace them, it more importantly reduces the weight of the mouse itself. Unless you have a good reason to want a wireless one, we think wired makes the most sense.

Similarly, while we think any good mouse contains at least three buttons and a wheel, five is better (with the extra two most commonly mapping web navigation for forwards/backwards). Any more than that is probably unnecessary.

The quality of the sensor may be of interest to high-end users – a higher CPI (counts per inch) value means better accuracy, while the inclusion of certain sensor



technology (such as Microsoft's BlueTrack) means better performance on differing surfaces, but the majority of users won't need to pay any attention to the sensor quality, because unless you do a lot of fine adjustment (such as aiming in an FPS or positioning small items while designing stuff), then even a cheap sensor will perform fine.

Note that while some of the most high-end mice are described as 'gaming' peripherals, that doesn't mean they're only useful for gamers – just that gamers are more likely to require their high-end features. Whether you're an animator, designer, coder or just very particular about your hardware, there's every reason to care about gaming-quality hardware even if you haven't touched a first-person shooter since *Doom* was popular.

Recommended Mouse: A lot of mouse choice is down to personal experience, but at £16 the Microsoft Comfort Mouse 4500 is probably the place to start if you aren't sure. The design is fairly basic, but it has an extra-accurate BlueTrack optical laser, the body is pleasingly large and shaped to fit both left and right hands, it has five customisable buttons and a dual-axis tilt wheel for scrolling around a page in any direction. You can probably find better or more comfortable mice if you spend considerably more time shopping around, but we struggle to imagine anyone finding this any less than adequate.

Keyboard

When it comes to choosing a keyboard, you can find prices running from a few pounds to more than a hundred. Most users will want something towards the lower end of the spectrum, but additional features such as wireless connectivity, media keys and individually microswitched keys can raise the price.

Again, the reality is that unless you can think of a good reason you need the extra features, it's worth sticking to the lower end of the market. Ultimately, it's the typing that matters, and unless you're willing to shell out for a mechanical keyboard, they all feel basically the same. In practice, most people don't use media keys, and if you're the sort of person who doesn't already, there's a strong chance you never will.

Wireless connections are slightly more useful on keyboards than on mice, not least because the battery doesn't significantly add to the weight of a keyboard, but at the same time, most wireless keyboards use an RF connection and a proprietary sensor, which means they're no more practical for use with other devices.



If you definitely want a wireless keyboard, try to buy a Bluetooth one. You may have to add a Bluetooth dongle to your system, and the keyboard itself will be more expensive, but it'll also be compatible with a much larger range of devices: smartphones, tablets, laptops, games consoles, TVs and more. A small number of Bluetooth keyboards have multi-device switchers, meaning they can be paired with more than one piece of hardware at once, so when searching for a Bluetooth keyboard, that's the feature to look for.

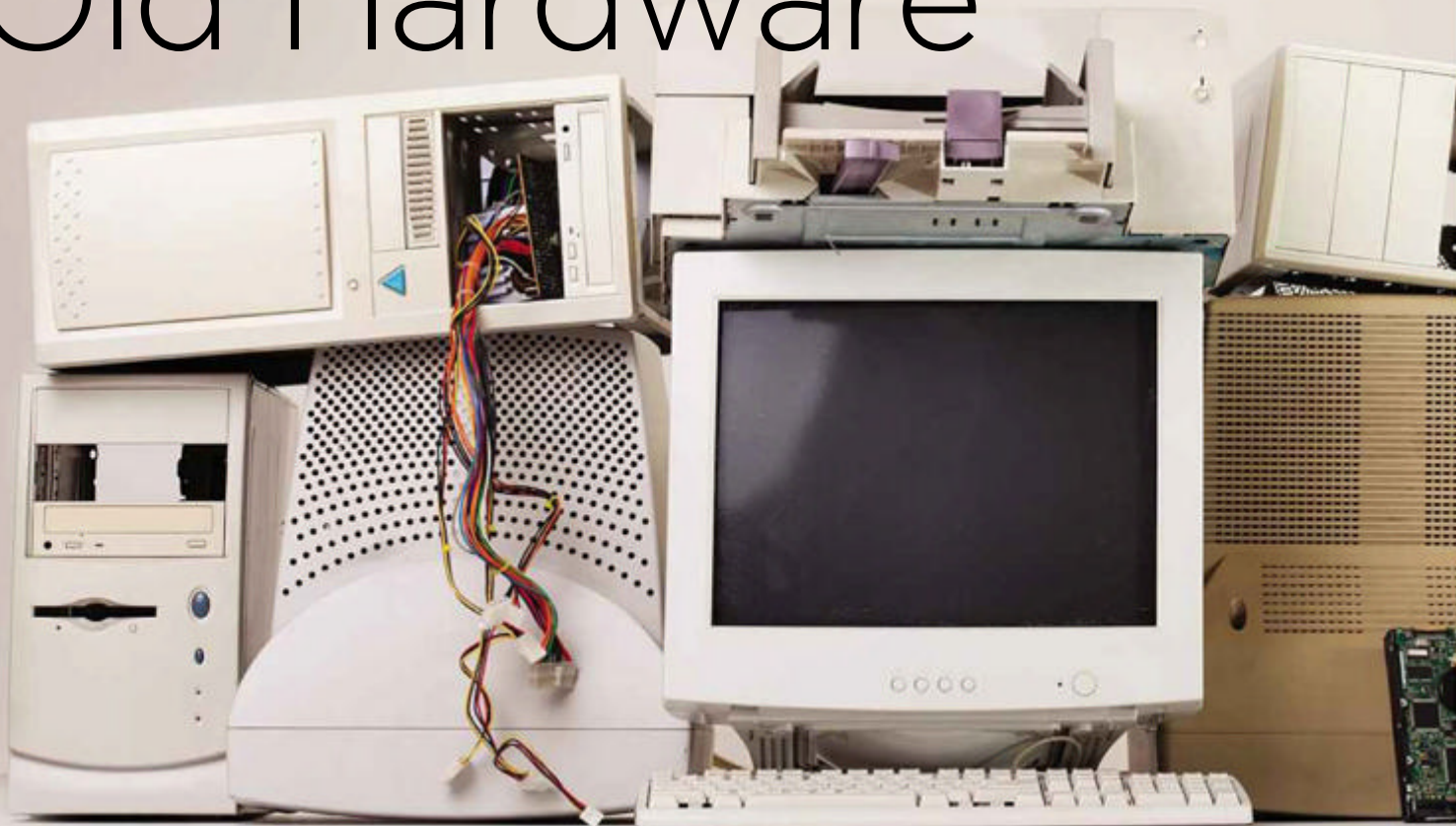
The only other keyboard feature you're likely to see is backlighting, and this is another one that's mainly found in gaming devices. The popular image of gamers is that they sit in darkened rooms, and there's some truth to that, which is why the keyboard allows you to find keys even in the dark. But good practice is to have proper illumination around you at all times when using a PC, and that's why we think backlighting is largely a gimmick rather than an essential feature.

Recommended Keyboard: For keyboards, you have two potential recommendations, because there's a huge

distinction between those devices with Bluetooth connection support and those without. If you just want the latter, a basic, no-frills keyboard is your best option, so go for the Microsoft Keyboard 200. At just £8 it has a standard 105-key layout with a 6ft cable and USB connector, but the Microsoft seal of quality means it feels good, and it won't fall apart two months after you buy it.

By comparison, if you want a wireless keyboard, then you need the Logitech Easy Switch, which is almost ten times more expensive at £75, but it has that all-important multi-device functionality (up to three), as well as being small and thin enough to carry around. Its Bluetooth, so you'll find it an ideal peripheral for your other mobile devices (including tablets), and the connection should be as strong and reliable as a cable but without the associated clutter, so at least you'll get your money's worth. For £20 more you can even pick up a backlit version, but again, if you need that feature you'd probably be better off spending the extra money on a desk lamp! [mm](#)

Repurposing Old Hardware



Don't just throw out your old parts. They might be more useful than you think

When you upgrade your system, it can be tempting to just chuck the parts you've replaced in a skip, or give them to someone else. After all, second-hand computer hardware is usually difficult to sell on, and there's no sense leaving it in a cupboard somewhere to gather dust.

But before you get rid of your old components, think for a moment about what else you might do with them. An upgrade isn't just about adding new hardware to your system; it's also about extending your system's capabilities, and with a few tweaks that's exactly what old hardware can do.

Obviously some components are single use. You won't find many ways to incorporate an old CPU or motherboard into your system, and your RAM either fits or it doesn't, but there some components and peripherals that can be reused in unexpected ways. Before you throw anything away, read through our guide so

“ **But before you get rid of your old components, think for a moment about what else you might do with them** ”

you know exactly what can be salvaged from obsolescence and how.

Routers

Although they look like quite simple boxes from the outside, routers are actually surprisingly powerful inside. You might not be able to tell from looking, but they house fairly capable CPUs, which usually run their own reduced versions of a Unix- or Linux-like operating system. This means that with the right coaxing, you can make them do far more than they initially seem capable of. If you imagine what a Raspberry Pi can do, that's about the same level of power we're talking about here.

If you replace your router with a new one, the temptation might be to simply chuck the old one away, but don't be so hasty. Even an average wireless router will probably have the ability to function as a network bridge or repeater, both of which allow you to extend your networks in different ways. Bridges provide wireless connectivity to non-wireless devices, whereas repeaters extend a wireless signal to areas with weak coverage, so both are fairly useful to have connected to your network.

How easy it is to tune a wireless router into either of these device modes heavily depends on the age and sophistication of the router, but a large number of models



won't even need so much as a firmware upgrade to get started. If your hardware doesn't seem to support it, you can also try installing custom firmware, such as DD-WRT, which can essentially give your hardware a free upgrade.

The world of custom router firmware is largely dominated by the Open WRT project (openwrt.org), which emerged because Linksys built the firmware for its hugely popular WRT54G model using open-source code. Since the inception of the project, it has expanded to cover a much larger range of devices and has averaged a major update every year since 2006. The current version supports a huge number of features, many of which are impossible to access on a router's standard software.

These features include, of course, the ability to give any supported wireless device the capacity to function as a repeater, access point, bridge, portal or a combination of the same. The huge amount of features and massive modification potential of OpenWRT is what gives it its fans, but it's worth noting that not every router supports every function, and many models aren't



supported at all. A full list of supported devices is available on the OpenWRT site.

And of course, if none of that sounds appealing, there's one thing you can do that requires almost no modification: by connecting your old router to your new one using the uplink port, you can extend the amount of physical ports on your network and create a second wireless guest network, which shares your internet connection but has different restrictions, so you can apply parental controls to your children's browsing or give access to guests and visitors without disclosing your actual password.

The main problem with reusing an old router is that it's likely to be slower than the one you replaced it with, which has the potential to create a network bottleneck. The good news is that since Wireless AC runs on both 2.4GHz and 5GHz frequencies, compatibility with the latest hardware shouldn't be an issue whether your router runs Wireless G or Wireless N signals. Restrictions beyond that are minimal: you need a plug socket to power it and the technical capability to administer the router. If you can get over those hurdles, the hardware you might have chucked away is simply ripe with possibilities for reuse.

Hard Drives

Hard drives are quite easy to repurpose and reuse, and the speed at which

storage space drops means it's not uncommon to have a spare hard drive lying around that can be put into service in more than one way.

Clearly, the way you reuse a spare hard drive is to create secondary storage for a system. Everything from your desktop system to your routers to your TV probably has the ability to connect to USB storage, and although most external hard drives use a 2.5" laptop-size drive (which can be powered solely over USB), this doesn't exclude you from using a 3.5" drive. All you need to do is buy an external drive caddy for as little as £10.

Drive caddies essentially allow you to turn any hard drive into its own external unit. They come with their own USB connection, and for 3.5" drives they'll also come with a separate power cable. Inside you'll usually find a SATA connector, but if you have an older drive, you should be able to find one with an IDE connector. Some units even come with an interchangeable connector so you can use both.

Once you have an extra drive, the question is what you use it for. If anything, the main obstacle to hard drive reuse is that the units themselves wear out comparatively quickly. It's rare for any computer component to die of old age, but hard drives have moving parts and require extremely high fidelity operation, which means that the average lifespan of a



home unit can be measured in years, after which point you risk seeing bad sectors and head crashes.

If you do reuse your hard drive, then, the golden rule is that you make sure it doesn't contain anything essential. Use it for temporary backups and storage, rather than anything long-term. Fill it with data you can afford to lose. That way, if it does succumb to the flaws inherent in its design, you won't feel like you've lost out.

We think that makes them best-suited for containing rippable and downloadable media, such as music and video, which can be fairly easily replaced in the event of a crash or data corruption. Attach the unit to your router's USB port, and the built-in DLNA server should allow you to stream your media from any device on the network, if not anywhere on the internet (depending on the sophistication of your router).

You can also use a hard drive to watch media on your smart TV or set-top box, but in most cases those devices can also use a hard drive as a recording device, which is another way you can use them: rather than fill them with media you've downloaded, you can fill them with media you've recorded off broadcast or use them as a buffer to allow you to pause and rewind live TV.

Of course, an external hard drive can be used for a number of other things, but the

power requirements of a 3.5" drive caddy mean that it's not especially portable and not particularly convenient for moving around a lot. Our advice is that you find a largely static use for it (which will also extend its life), so using it as a media library ticks all the boxes.

USB Sticks

USB storage keys are now so cheap and throwaway that if you've acquired one

recently, it's probably because it was given away free as a promotional item or placed inside a novelty-shaped keyring that one of your distant relatives bought you at Christmas. But this means that these once-prized pieces of hardware are increasingly ending up consigned to drawers and boxes, never to be used again, when they could be helping you in your daily life – not necessarily as storage either.

For example, you could use a USB drive to create a boot drive, which is useful both as an emergency recovery disk or as a portable system that you can access from any PC with a USB port. A USB drive can easily be imbued with a specially modified copy of Linux (Puppy Linux and Pendrive Linux are two organisations distributing versions well suited to this task) or even bootable versions of Windows using utilities like WinToFlash. The result is a portable system that you can access on other people's computers or if your own stops working.

If you're feeling paranoid, you could even do the opposite and create a USB 'suicide disk', which can wipe a system in seconds. Creating a suicide disk is a fairly easy process. If you want to do it for free you can use Darik's Boot and Nuke (available from www.dban.org), which does all the difficult stuff for you. When installed on a USB drive, DBAN will automatically and completely delete the contents of any hard disk that it detects, making it an appropriate utility for bulk or emergency data destruction. The commercial software Active Killdisk will do the same to a variety of professional standards and can be downloaded from www.killdisk.com.

Donating Your Hardware

Even if you can't find something to do with your unwanted components, that doesn't mean you should just chuck them in the bin. Just because you think your old hardware is useless, that doesn't mean that someone, somewhere can't put it to work. Several organisations around the world will take your old PC components off you and recycle them for use in the economically developing world.

Organisations like RecycleUSB (recycleusb.com/index.php?/start-recycling) turn unwanted USB drives into devices containing 'Sugar on a Stick', a USB learning-centric operating system (based on Fedora/Linux) that can be deployed as an educational tool. Computers for Charities (www.computersforcharities.org) will accept old systems and either repurpose them for use by charitable organisations or safely recycle them once the condition has been ascertained.

The catch here is that very few organisations will accept the donation of individual computer components, especially those that don't have their original packaging. In this case, we recommend that you find a way to recycle them instead of throwing them away instead. Guides can be found in various places online (www.recycling-guide.org.uk/materials/computers.html is one good example), but the short version is that you can usually take them to your local waste centre or, in some cases, return them to the manufacturer for proper disposal. If you're not sure what to do, your local council website should contain the necessary information.



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“ If you’re more interested in harnessing the purer computing power of an old system, you could follow a different route and turn it into a dedicated server ”

On a completely different tack, if you have a game console, you might be able to use it to add storage to the device. Certain games consoles support USB for a variety of uses. Microsoft, which for years delighted in charging inflated costs for tiny hard drives to use as storage space, now allows you to format a USB key to the Xbox 360 or Xbox One file system (through the dashboard) and use it to store saved games, backups and profile information. It won't be readable on your PC any more without a reformat, but it's far more cost-effective than buying a memory card!

Alternatively, you can leave your USB key in the Windows format and use it to store media, such as videos and music, which you can then play through your console. Wii users, unfortunately, are out of luck – the console does not officially support USB storage.

Finally, you could use your drive to create a hardware lock for your system. Security dongles aren't normally used on home systems, but you can easily create one using a USB key. Just download and install Predator (tinyurl.com/predusbmm), select a USB drive to use with it, then follow the setup instructions. From that point on, as long as predator is running (you can set it to launch with Windows) the USB key will need to be connected to your computer in order for it to function. Pull out the USB key, and the keyboard and mouse stop working and the screen goes dark. Plug the drive back in, and it's all instantly put back in working order. Useful stuff – and it'll make you feel a bit like a secret agent at the same time!

Monitors

A new monitor can be a thing of beauty. In fact, just upgrading the monitor can

Quickfire Reuses

1. Optical Drives

As with hard drives, a spare optical drive can be repurposed into an external drive using a drive enclosure. They're considerably less useful, we admit, but in an era where high-end laptops are increasingly forgoing the inclusion of an optical drive to reduce weight and save space, it might not be a bad idea to have an external DVD drive around in case you realise that the file you desperately need is only available on a backup DVD.

2. Keyboards

Replaced a keyboard? Before you throw away the old one, try it out on your smart TV, set-top box or games console. Inputting usernames, passwords and search terms with a remote or games controller is tedious work, and if there's a USB slot free, it's a safe bet that it'll pick up your keyboard and allow you to get straight to the point the next time you want to search for a film on Netflix.

3. Speakers

If your speakers still work, why not take advantage of the universal nature of the 3.5mm audio jack and repurpose them as a sound system for your MP3 player, smartphone or tablet? Old PC speakers make a fantastic low-cost alternative to expensive Bluetooth-based docking stations, and even a cheap pair will display much higher fidelity than the tinny tweeters inside most mobile devices. Stick a pair in the lounge or kitchen and they'll give you sound better than any radio.



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sometimes make it feel like you have a completely new system, so reusing an existing one might make it feel like you're holding your computer back unnecessarily. But it's always useful to have a second screen around, and if your desk is big enough, then why not take the ultimate step and run your system in a multi-screen configuration?

Previously confined to movies about hackers, the advent of cheap and long-lived LCD monitors means that multi-screen systems are within the reach of the average user. Buyers are more likely than ever to buy a new monitor, because they want to upgrade a working screen rather than replace a dead one. Sure, your existing monitor may not have bells and whistles like a 3D polarised screen or super-high refresh rate, but Windows isn't picky. All you need is a spare HDMI, DVI or DisplayPort cable and it'll connect to both.

Running a dual-screen system has many advantages, not least if you're the sort of person who likes to watch TV or keep one eye on Twitter while working. If you have more than one system in your home, you could even use VNC to telnet into another computer, or use screencasting software so it becomes a mirror of your tablet or phone. There's a surprisingly large

“ Why not take the ultimate step and run your system in a multi-screen configuration? ”

number of things you can do with a spare monitor that make computing both easier and more powerful, and they're far more valuable to the average user than the £50 you might get from selling an old screen-second hand.

Luckily, the disadvantages of using a second screen are negligible. The option may be unavailable if you only have on-board graphics capabilities, but in most cases any card with two output ports will be capable of multi-screen output. Of far greater concern are the abilities of the monitor itself. If it has a significantly lower resolution or screen size, or noticeably poorer brightness and contrast levels, it might be aesthetically displeasing to use. If your desk is small, it could simply take up too much space to be worth using, and you will have to devote extra resources to running it. But by most reasonable criteria, a second monitor is useful enough to compensate for any of these smaller issues.

And even if a second screen isn't what you want, look at it this way: LCD monitors are essentially televisions with the broadcast receivers ripped out. Buy a cheap Freeview set-top box / Apple TV or similar and you essentially have a new TV, which you can put in any room you like. There are a few small problems you might encounter: if your monitor doesn't have integrated speakers you'll need to buy a pair and make sure you have a set-top box with a compatible audio-out connector, but even then, it's cheaper and more versatile than buying a new TV.

Complete Systems

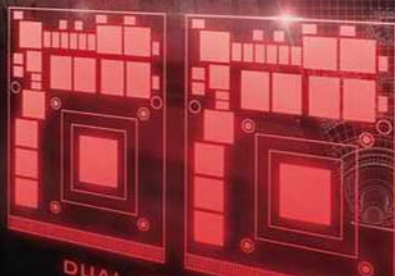
If you've replaced a computer system in its entirety, you might wonder if there's any way you can reuse it productively without having to buy an extra monitor and peripherals. Assuming you don't want to donate it to a worthy cause, there are a few ways you can repurpose a system in

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your own home that don't involve the case propping up a shelf in the wardrobe.

One interesting project you could try is to turn the system into a NAS device. Network attached storage can be an incredibly useful addition to a home, and if your router doesn't support external storage (or you want to add a multi-drive storage solution that supports high-end features like RAID, rather than a simple single-drive solution), then the husk of an old system can be easily repurposed.

All you have to do is bung in a couple of new hard drives (ideally in a RAID array), and it'll be as fast, sturdy and reliable as anything you can buy on the specialist NAS market – if, admittedly, a little larger and noisier. Use it for backups and/or as a file server, perhaps using software like FreeNAS, and compensate for the lack of a monitor and input peripherals by installing TightVNC, which allows you to remotely log into it from your normal

desktop system (or indeed, laptop, tablet or smartphone).

Along similar lines, you could turn it into an HTPC. Like a NAS device, an HTPC doesn't need its own monitor, but in this case that's because it'll be connected to a TV instead. All you have to do is fill your system with media, install a front-end like Kodi (the former XBMC) and invest in a remote control, and you'll have a system that can store and serve your entire video library on demand like your own personal Netflix. This is ideal for old laptops and mini-towers that are small enough to fit beneath a TV cabinet (and quiet enough not to interrupt you). Buy a game controller and you could even turn it into a retro gaming console with the use of a few emulators!

If you're more interested in harnessing the purer computing power of an old system, you could follow a different route and turn it into a dedicated server –

perhaps for your favourite multiplayer game or for a distributed system like Folding@Home. There's something particularly fun about having your own *Minecraft* server for you and your friends to play on, though you might be content in the knowledge that your PC might help develop a medical treatment that eventually saves the life of you or someone you know. All you donate for these privileges is the small amount of money it costs to run an extra system alongside your main one.

And of course, rather than do any of these things, you might want to sell it! While old components are largely impossible to make any money on, there's always demand for working systems, and you'd be surprised what still sells. If you do decide to sell your system on, remember to secure your PC before you get rid of it, so you're protected against fraud. Wipe the hard drive thoroughly before selling on any system!

So there you have it. Plenty of ways to repurpose old hardware so it actively benefits you. Maybe next time you're about to consign that disused hardware to the bin, you'll think twice and see whether there's something else you can do with it instead! [mm](#)

“ You could use your drive to create a hardware lock for your system ”



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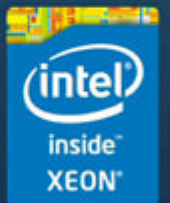
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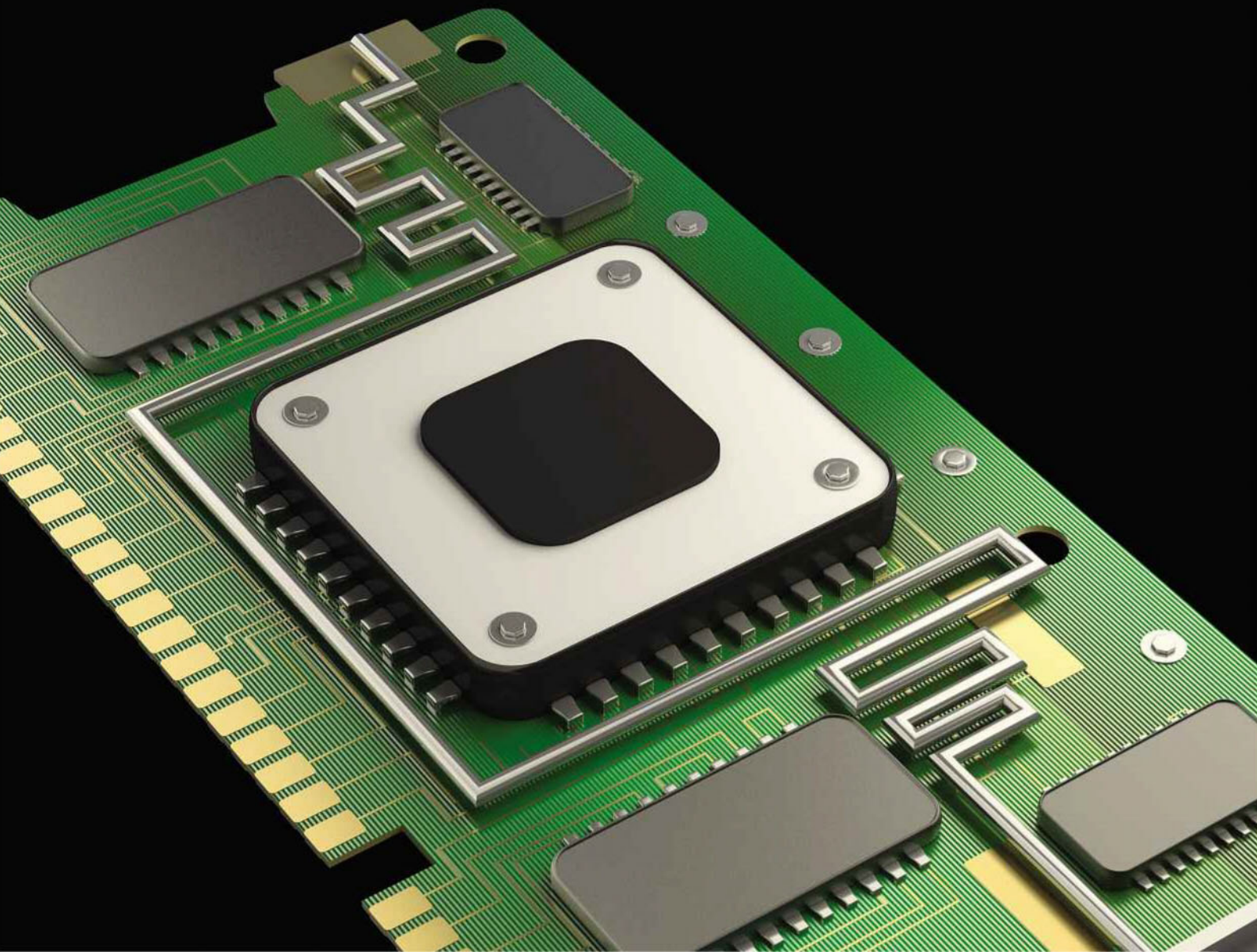
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Graphics Cards:

Old Vs.
New

Upgrading a graphics card could make a real difference to your system, but knowing if you need a new GPU and how much to spend can be tricky

If any part of your system costs more than the processor, it's a safe bet that it's the graphics card. That makes choosing a the right GPU a particularly important (and expensive) part of any upgrade plan. Should you go straight for a new card, though, or will an older one deliver better value? if you're putting together a new system, how bad does your graphics card have to be before replacing it makes more sense than keeping it? We'll answer those questions, and more, as we try to find out how you get the best value out of a new graphics card purchase – and whether you need to make one at all.

Is An Integrated GPU Enough?

Most modern processors have an on-board GPU, so the question of whether you transplant your graphics card into a new computer, buy a new graphics card or simply let your new on-board GPU take the strain relies heavily on how good your previous graphics card was and what you're planning to use it for.

'It depends' is something of a cop-out answer to this question, though. The simple truth is that, in many cases, the answer is 'yes'. On-board GPUs are more than powerful enough to run HD video and keep desktop performance in order, and it's only when it comes to the kind of 3D visuals most games require that they start to struggle. If you're building a gaming system, you'll need a separate graphics card. If you're not, then an on-board GPU will be enough.

It's worth noting, however, that the older your Intel CPU is, the worse its GPU is in rather sharp terms. An Intel HD Graphics 2000-series chip (as found on Sandy Bridge) is about a

third as fast as an Intel HD Graphics 4000-series chip. Even the 3000-series graphics are only half as fast as a 4000-series GPU. If you're trying to future-proof a system, don't rely on older integrated GPUs to protect you from the upwardly creeping demands of your system for long.

However, if you can't afford a separate GPU, then there is at least one ray of hope: AMD's Kaveri chips have ramped up their on-board graphics performance significantly. Since AMD's CPUs can't compete with Intel's on single-threaded performance, AMD has tried to make them more attractive by putting better-quality GPUs on them. The latest APUs incorporate Radeon R7 GPUs which are frankly superb compared to even Intel's HD Graphics 4600 GPU. If your plan is to get the best gaming performance without buying a separate graphics card, then a Kaveri APU is a better choice than Intel's ostensibly better chips – even though in absolute terms, integrated graphics are always well behind the pack.

Should You Re-Use An Old Card?

If integrated graphics won't meet your needs, you may have the option to transplant an old graphics card into your new system, but whether or not it's worth doing is an important question to answer. If the card is getting on a bit (i.e. it's more than couple of generations old) then in all probability, the on-board GPU will perform just as well (if not a little better) for any task that isn't related to gaming, and it's probably not worth salvaging your old graphics card.

Luckily, if your card is only a year or two old then it probably is going to be an improvement on your integrated GPU. Even the best Intel Haswell and Kaveri chips offer graphics integrated performance which is worse than discrete cards from several years ago. If you have a Nvidia GT 630 or AMD HD 7000-series card (both of which came out in the early half of 2012) then they'll

outperform the on-board GPU of even the most high-end processors on the market. We can even put a number on it, because you can buy cards like this for £30-£40 new, and they cost even less second hand.

However, if your current graphics card turns out to be worse than your on-board GPU, there's no question that you should dump it. In all but a small number of cases, having two different GPUs in your system offers no tangible benefits. The main exception is the way certain AMD and Radeon chip combinations can run an integrated and an on-board GPU in SLI with one another, but it's quite unlikely you'll have the right setup (though do check – you need exactly the same GPU on your card and chip).

In most cases, the system simply uses one GPU or the other. By running both in a single system, all you're doing is wasting power. That's no idle threat either. GPUs are often among the most power-hungry components of a system, so it will actually cost you money in a small, though real, way to run a graphics card you're not using.

If you decide that your old card is worth using instead of a GPU, the good news is that there aren't a lot of things to worry about. You'll save a fair amount of money and all you have to do when transplanting it from system to system is make sure it remains well-ventilated in its new home, and that it sits in the correct PCI slot. If you have a can of compressed air around, it couldn't hurt to blow out some of the dust out of the fan and/or heatsink either. A clean graphics card deals with heat better and can therefore run quicker and quieter. A few seconds of attention should mean that once it's moved over, your old graphics card can run like new.

Buying A New Card

If you have to buy a new card, this is where things get tricky. You have two options: buy a current-gen card and pay the premium you get on all of the newest hardware or



“ If integrated graphics won't meet your needs, you could transplant an old card into your new system, but whether or not it's worth it is an important question ”



Graphics Card Upgrade Tips

If you have to buy a new card, it can be difficult to simply jump into the market. So here are our tips for navigating the increasingly choppy waters of graphics card upgrade selection.

1. The Amount Of RAM Isn't That Important

RAM might be crucial to proper operation of most PCs, but having a lot of RAM on a graphics card is a bit like having a large fuel tank on a sports car: it won't make it go faster. Having a lot of graphics memory is only useful when you're running large resolutions or multiple displays. Of greater importance is having better memory bandwidth, and that's simple to explain: GDDR5 is twice as fast as DDR3, so given the option almost any amount of GDDR5 on your card is better than any amount of DDR3.

2. Be Wary Of SLI And CrossFireX.

If you have a lot of money to spend, you might think of treating yourself to a multi-GPU system, but the fact is that two cards won't give you double the performance. It'll require twice the resources, so your system will eat a lot of power and chuck out a lot of heat, but the performance in-game will only equate to 25-50% better speeds. Again, multi-GPU systems actually work best for multi-monitor setups, so if you haven't got that you might as well stick to a single card.

3. Don't Create A Bottleneck

One of the bigger misconceptions in gaming is that a fast GPU can compensate for a slow CPU or vice versa. The reality is that if the difference is too big, one will bottleneck the other. To avoid this, team mid-range CPUs with mid-range cards, and so on. Ideally you want them both to cost around the same amount. If your CPU was a Core i7 costing £270, then a GTX 970 would be perfect. If you have a £90 core i3, then an R7 260X is the perfect fit. The rule breaks down at the extreme high and low ends of the market and you do get a little leeway, but it's a good rule of thumb to follow. If you're pairing a £90 with a £290 graphics card, something's gone wrong somewhere!

The good news is that, rather than focusing on specific models and lines, you can use price as a cut-off point. At present, the best graphics cards can be picked up just under £300. Above that you begin to pay a premium on performance, and that's worth avoiding because it means you can improve your system more by spending the same money elsewhere. Stay below this amount and you can guarantee that you're getting the best performance your money can buy.

For Nvidia cards, the best in this price range is the GeForce GTX 970, which performs better than all 500-series cards, and the GTX 680/780 and worse. The only cards that come close to matching it have been discontinued at retail, so even if you can find some on sale they'll probably be expensive older stock that hasn't sold through, so don't buy one unless you're sure you're getting a particularly good deal on the price.

While the AMD equivalent at this price bracket is the R9 290X, the better value card is actually the R9 290, which is some £70 cheaper and hovers around £220-£230. The two cards have surprisingly similar performance given the difference in price. What's more, if you overclock the 290 you can achieve results as good as the 290X without spending much money, so it's definitely the better value card. Both the R9 290 and the R9 290X are faster than all previous-generation AMD cards with the sole exception of the HD 7990, though the HD 6990 and HD 7970 are both almost as good.

buy an older one and sacrifice long-term compatibility. The idea is to find the 'sweet spot' for your graphics card – the point where you're getting as much performance for your money as possible without also buying into

a false economy and missing out. Short-term savings for long-term disappointment isn't a smart way to upgrade your system, but knowing the difference between that and genuine economy can be difficult.



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It's ultimately the R9 290 which wins the battle of high-end cards, though, at least where value is concerned. It might not be quite as powerful as the GeForce GTX 970 and R9 290X, but where those cards are no more than 10% faster even on their best day, they both cost around 25% more, making them slightly worse value. If you want to buy the best high-end card, the R9 290 is the one – just make sure it's a significant upgrade over your existing card before you spend the money.

By applying the same logic that helped us identify the best GPU upgrade, we can also figure out the least amount of money you should think of spending on a cheap one. Specifically, in that case, we reckon the cut-off point for low-end cards is found just under £100. Spend any less than this and you're paying largely for the manufacture of a low-end card, rather than the extra performance it offers. A £90 card is generally more than twice as good as a £45 card, for example.

If such a budget purchase is your preferred path, then you can find a couple of good cards around this price point that are definitely worth considering. First on our list would be the Radeon R7 260X,

“ It's ultimately the R9 290 which wins the battle of high-end cards, though, at least where value is concerned ”

which starts at about £90 and performs about as well as 2013's Radeon HD 7790. Slightly better, in fact.

Rest assured, what you will get out of that is well above the level of any integrated GPU, so if you have no card it's going to provide a substantial leap in the quality of visuals your system can provide when gaming – though if you have a card that's already in the same league as the HD 7790 (such as the HD 5850, HD 6870, HD 6990M or any better card) then an R7 260X isn't going to be worth the money.

Along similar lines, the best entry-level Nvidia card is the GTX 750, which also has the advantage of being about about £10 cheaper than AMD's entry, but with the downside of having a much higher TDP; so you could end up paying that discount back in electricity use over time. Basically, this boils down to the fact that

the card uses less efficient architecture (it needs more than double the power, at 115 watts) so your system will run hotter and also put more strain on the PSU. Compared to older Nvidia cards, the GTX 750 runs about as well as a GTX 560 or 650 Ti, so buying a new card if you have those (or anything better) would be an unnecessary upgrade.

Ultimately, though, buying the right graphics card is as much an art as a science. We highly recommend you are careful not to get too swept up in small differences and minor price variations between similar models. Certainly sections of the online community will rail against specific models and manufacturers with convincing passion but, ultimately, if the card is doing what you want, it's good enough for you. Don't let anyone try and tell you different. [mm](#)

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Improve Your Storage

James shows how to get the most from your hard drives and SSDs

Storage is a constant concern with any system. If you're not worried about the amount of space you have, you might be worried about the speed it runs at or the gradual effects of aging – not to mention the ever-present, unpredictable threat of a catastrophic drive failure.

For those reasons, improving your system's storage should never be too far from your mind. And in case you're not sure how much thought to give it, we've put together this collection of our tips and expert advice for making storage upgrades.

Replacing Your Hard Drive

Replacing your hard drive with a new one is one of the simplest upgrades you can make to a system, assuming you have space to hook an additional drive up. And if you haven't, it's probably because you've done it before.

Assuming you don't want to do a fresh installation of your operating system, all you have to do is open your PC, connect the new hard drive's SATA data and power connectors up, boot your PC, copy the data from the old drive to the new drive, shut down your PC, disconnect and

remove the original drive and then install and reconnect the new one in its place. If you're a rookie, the only truly difficult part is making sure all the data is copied over, so use a transfer utility such as 'Windows Easy Transfer' to ensure that it's been done properly.

Mounting the now operational drive doesn't require a huge amount of thought. It's good to leave a fair amount of space around the drive to minimise heat retention, but it's incredibly rare for hard drives to be negatively affected by heat build-up, so take that advice without too much urgency. Most of the real problems are only likely to occur when you first connect the new drive up. If you make it past that point, the hard part is done.

If you're unlucky and the new drive doesn't appear in Windows, the first time you connect it up, you'll need to check in your BIOS whether the hardware is actually being detected by your motherboard. When you boot your system, enter your BIOS menu (you usually have to press F2 or Del when you hear the POST beep to get to that point) and find the SATA settings. Usually, this will be under the heading 'integrated peripherals', but it may be something more straightforward, like 'storage'.

In the BIOS, you should be able to see the new drive listed. If you can't, check that your drive controllers are all enabled. If they are, switch off the PC and double-check the data and power connectors. Unless something is faulty, it should be visible in the BIOS. You may want to try using different SATA ports and cables to check. As a last resort, swap the SATA power and data cables out of your working drive and into the new one. If it still doesn't work, it's likely something serious is wrong with the drive.

If the drive appears in your BIOS but not Windows, you'll have to look at the Windows device manager. Find the drive under the 'Disk Drives' section. If there are any problems affecting detection (such as a driver issue), then you should be able to find a notification and resolve it here. Try removing the drive, rebooting and then allowing it to auto-detect again. If that doesn't work, it's likely some serious problem is affecting it, and it might be worth finding a replacement.

It's worth noting, of course, that if your old hard drive is still in a usable condition, it doesn't make any sense to throw it out completely. Instead, you'll have to make a few more decisions about how to use it.

Adding A Second Drive

If you add a second drive to your system, it often makes more sense to replace your primary drive with the new one rather than use the newer drive as a secondary storage unit. There are circumstances in which this doesn't apply, but it's easy to work out whether you should keep an old drive or not by following these simple rules:

1. Make Your Primary Drive The Biggest SSD You Can Afford

SSDs have super-quick access times, which make them ideal for running software from. Given the speed of modern CPUs, hard drive access times create a surprisingly

large bottleneck for system performance, and Windows feels that particularly keenly. Run your operating system off an SSD, and your computer will boot faster and run more smoothly.

The only potential hitch is that 'largest SSD' might still be quite small in absolute terms. Ideally you want your SSD to be around 200GB in size, and we wouldn't recommend trying to run Windows off an SSD that was less than 100GB in size for any long period of time.

If you're adding your first SSD to a system, it should absolutely be the primary drive. If you're adding a second SSD to your system, then unless one is significantly smaller than the other, you'll have to go to rule 2.

2. Use The Newer Drive As The Primary One

Not all of us can afford (or particularly want) an SSD, but if you have two mechanical drives to pick between, then you have to weigh up your options.

For the most part, mechanical drive performance is fairly flat across all brands, with similar access times and drive speeds. Unless you have one drive that is significantly slower (perhaps it's a low-noise or energy-efficient drive, for example), then you're certain to get better performance out of whichever drive is newer.

This is partly because the newer drive won't have a cluttered, fragmented file system and partly because bad sectors become more likely to appear on drives as they age. The older your primary drive is, the greater the chance something catastrophic can happen to your data.

In practical terms, any recent mechanical drive will have a good enough capacity to run Windows and applications without space becoming an issue, so there's no need to take the size of a drive into consideration. Use age as a rule of thumb, with speed as your secondary concern: a five-year old drive is probably too old to trust with a fresh Windows installation, regardless





of size. If the drives are close in age, then a 500GB drive isn't any more likely to run Windows better than a 1TB drive, but a 7200rpm 3.5" drive will give better performance than a 5400rpm 3.5" drive.

3. Don't Forget To Recondition Your Old Drive

Most systems support at least two 3.5" drives, and as many as four isn't uncommon (though you may need to install 5.25" bay converters so you can properly mount them all), which means that if a hard drive isn't in good condition and not nearing the end of its operational life, you can easily reuse it.

For various reasons it's not a good idea to leave Windows intact on your secondary drive. Some applications might get confused by the presence of two Windows systems, and there's always the chance your boot loader will have similar trouble making the distinction. Even if you've done a fresh installation on your new primary drive, you'll have to do a bit of spring-cleaning before you can consider it ready to put to work.

At its easiest, all you need to do is open the drive in Windows Explorer and delete the contents you don't want. If you cloned the drive to your new primary storage, you can simply quick format the drive to leave it empty. If you didn't clone the drive but want to keep some of your data (like documents and software), you'll need to manually sort through the files and delete the ones you don't want.

If you're keeping files on there, it might be a good idea to take advantage of the additional space and defragment the drive, which will consolidate the files and free space, speeding up access times. If you're wiping the drive completely, there's no need to do this. In both cases, run a full scandisk just to evaluate the condition of the drive. If you see bad sectors, it's starting to die and probably ready to be junked. If it doesn't have any major errors, you can continue using it as normal!

Using A Second Drive In RAID

If you have two mechanical hard drives with the same capacity, the simple thing to do is to run them alongside one another. But the smart thing to do is set them up in a RAID array. RAID stands for 'Redundant Array of Independent Disks' and means that multiple drive units are being run together as a single unit. Depending on the type of RAID array you run, you can either vastly increase access speeds or vastly improve data integrity.

Before you embark on a RAID setup, it's worth bearing in mind that RAID isn't necessarily intended as a home-user technology. While you will benefit from having a RAID array in your desktop system, its strengths are amplified in the context of multiple users accessing a single disk array and in situations where data integrity is critical. That doesn't stop you setting one up for your own use, of course, but it does mean that it's more of a fun project than a practical necessity.

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There are multiple ways to implement a RAID array, using varying amounts of drives for varying purposes, but most are either deprecated or aimed purely at high-end enterprise use. Instead, you'll probably set up either a RAID-0 or RAID-1 array.

RAID-0 uses disk striping to share the read/write load over multiple drives. Unlike most versions of RAID, it has no built-in redundancy (hence 'zero'), but it does allow you to access the combined capacity of the arrayed drives (so two 1TB drives would give you 2TB of usable space, rather than 1TB) while still receiving the speed benefits of RAID's simultaneous read/write capabilities.

The flip side of this is that there's no built-in fault tolerance, so your data is no safer than on one individual hard drive, and indeed, much less safe. If one drive spontaneously fails you'll lose half of all of your data, leaving the other half unusable. It would be like ripping half of the pages out of a book. The remaining half would also be unusable. Keep this in mind if you're thinking of running an old and new drive together. RAID-0 reliability is only as good as the worst drive, so it's best done with pairs of new drives.

The alternative – and the better option if you're running an old drive with a new drive – is RAID-1. Also called 'disk mirroring', it has no striping and simply duplicates read/write actions across drives. The redundancy can sometimes speed up reading data if the controller supports duplex read, but writing data doesn't have the same advantage: disk write performance for RAID-1 is the same as for single-disk setups. This type of RAID is best for situations where multiple users are accessing the same data, and it's known for providing the best fault tolerance of any RAID setup. If one drive fails, you can simply continue as normal using the mirrored copy until the broken unit is replaced.

It's also possible to combine RAID-0 and RAID-1 into RAID-10 (sometimes called RAID 1+0). This form requires four drives and stripes data across two pairs of mirrored drives, ensuring maximum speed and robust redundancy, although at quadruple the cost of a single drive, it's often too expensive to be worth using, particularly in a home environment!

It's worth noting that running SSDs in RAID isn't really worth doing. One of the main reasons RAID configurations increase access times is because mechanical hard drives are, quite simply, slower at shifting data than almost every other component in a computer. When it comes to SSD drives, the principle may be the same, but SSD drives are already so fast that the benefit is much lower. Indeed, if you try to stripe more than four SSDs, you'll probably end up slowing access times down!

One of the downsides of striping SSDs is that SSD drives are still comparatively expensive, especially at the lower end of the market where the initial manufacturing cost makes up a large part of the price. RAID was originally created to avoid the premium on larger hard drives, but buying two small SSDs is invariably more expensive than buying a single unit of equal capacity, regardless of what level of the market you look at. And while paying more for two SSDs will give you extra speed over a single drive, it also halves reliability, so the economics aren't particularly smart.

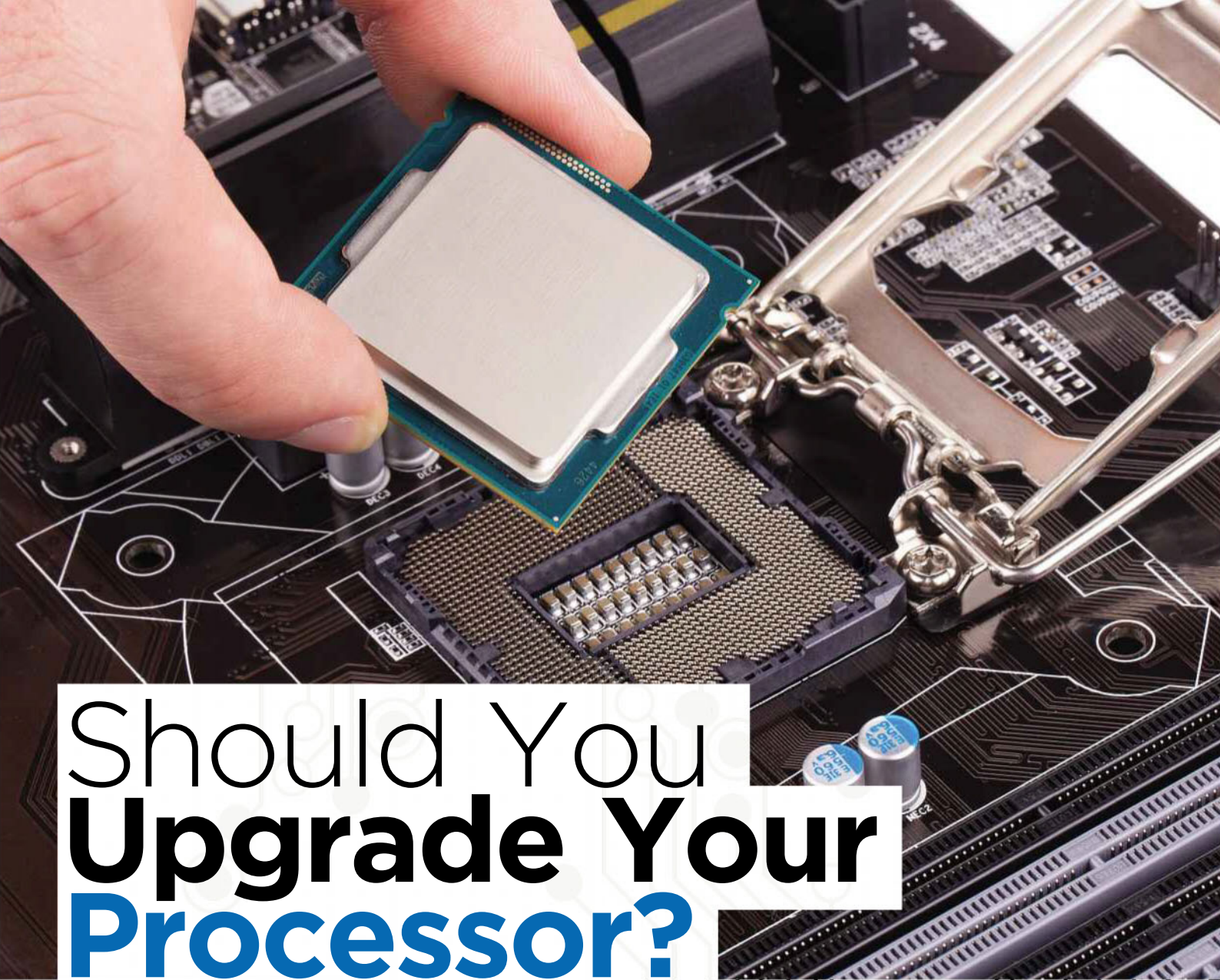
Still, RAID is definitely a way to improve mechanical drive storage, so if you have a second unit the same size as your old drive, it might be worth considering. Instructions for setting up a RAID array would fill an article in its own right, but if you want to try it on Windows, you can find instructions in Microsoft's Knowledge Base. [mm](#)



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Should You Upgrade Your Processor?

We look at whether you really need to get a new CPU

Upgrading your processor is always a big deal, and in many systems it's the most expensive upgrade you'll even make – not just because CPUs can be expensive, but because it often requires you to buy a new motherboard and potentially new RAM, and maybe even a new PSU just so it can happen! In many cases, a CPU upgrade isn't a simple old-for-new swap; it's a major piece of invasive surgery on your system.

So how do you know when a CPU upgrade is worth doing and when it should be avoided?

Before you upgrade a CPU, it's a good idea to rule out any other upgrades that might help. If your problems are that your system boots slowly and

programs take a long time to load, an SSD would almost certainly provide a bigger performance leap than a new CPU would, since modern CPUs are so fast that the hard drive frequently slows them down far more than their own workload does.

If you already have an SSD, then more RAM is also useful for general system performance. Extra RAM helps speed up application usage, especially when multi-tasking, and makes things like media-editing smoother and quicker by keeping more data in the fast-access memory. Unless you have more than 8GB of RAM, you should see a fairly noticeable improvement in your system's

general performance by putting more memory in it.

If you're planning to upgrade your CPU to make games run better, then a CPU upgrade might be useful, but before you spend any money, be aware that it's almost overwhelmingly a better idea to look at upgrading your GPU first. A game's graphical output is what makes up the majority of its drain on a system's resources, but improving a CPU has only a negligible effect on visuals compared to improving the GPU. If you get a new GPU you improve the visuals and free up any CPU resources that were being diverted to graphics for other types of processing, so there's a two-step improvement.

The exception to this rule is if there's a particular disparity between your CPU and GPU. If you have a low-end gaming CPU (such as an Intel Core i3) but a high-end GPU, then it's probable that your processor is bottlenecking the GPU and your game would see immediate benefits from a CPU upgrade, but unless there's an obvious difference between the capabilities of the two devices, a GPU upgrade is more likely to improve your game.

In most cases, the only time it makes sense to upgrade the CPU before any other component is if you're having trouble with explicitly CPU-intensive applications. This might include video and audio encoding, 3D



SHOULD YOU UPGRADE YOUR CPU?

rendering and anything that involves number-crunching, such as Bitcoin mining, distributed systems and specialist scientific/mathematical software. And lastly, if you're playing a game that is intensive on the processor but not the graphics, such as *Elite IV*.

If those sound like oddly specific examples, that's because they are. It's actually quite rare that a CPU is the cause of a system's bottleneck compared to the rest of its hardware, and the disparity is even more pronounced outside the gaming sector. With games it's a fight to keep the GPU and CPU up to each other's standards, but almost any other type of home computing is limited by some other factor.

If you're worried that your CPU is the cause of a system bottleneck, you can use a program like HWMonitor (www.cpuid.com/softwares/hwmonitor.html) to get some hard stats on the subject. Locate the statistics for your CPU and run whatever process you think is being slowed down by your hardware. If your CPU starts running at 100% capacity for

extended periods while slowness is occurring, you've confirmed it.

To check this in the free version, look under the CPU and read the 'UC utilizations' values. The first value is the current usage, the second is the low and the third is the high. It will probably hit 100% during any slightly intensive task, so don't worry about that; the problem is if the first reading hits 100% and stays there. If you want to monitor the situation more closely, the Pro version of HWMonitor offers graphs of performance too.

Of course, we've only looked at this question from one angle so far: what outcome do you want? An alternative discussion can be had if you consider what's economically viable.

If you have a low-end Intel CPU, for example, you might find that your socket allows you to move up to a vastly more powerful chip without changing any other components in your system. A Pentium or Celeron-based system has a motherboard that will support up to a Core i7 chip, provided it uses the same generation of socket. That's

an enormous leap in system performance without any further upgrades required.

It's true that there's a small chance you'll need a new PSU to power the chip, but compared to a high-end graphics card (which will almost definitely need a new PSU) or a chip upgrade that requires a new motherboard (and possibly new RAM) to be compatible, a new CPU of the same generation is suddenly a rather economical way to see a general leap in your system's performance.

At the opposite end of the spectrum, a good time to know that it definitely *is* time to upgrade your CPU is if you've taken the current platform as far as it can go. If you're running a Sandy Bridge Core i5, even shelling out for a Sandy Bridge Core i7 isn't going to result in a major performance increase compared to the latest platform. If you're running the best AMD APU but it's still not enough, you have no choice but to seek out a faster chip, and that means looking at another platform.

While we might sound reluctant to recommend a CPU

upgrade in general, it's only because it's often an expensive way to fix the wrong problem. The good news is that any CPU upgrade – even a small one – will definitely improve the way your system works. It might not be the best way to get a performance increase in the specific area you want to improve, but it is virtually guaranteed that you'll get one, and as an added bonus, that improvement will affect almost everything you do as well.

So look at it this way: more RAM might help you multi-task better, and a new GPU might speed up your games, but a fresh CPU will do all that and more. The truth is that due to the number of factors involved in keeping PCs running quickly and smoothly, it's hard to give a comprehensive advice on whether or not to upgrade a system. That said, there's some good news: while it's almost impossible to say whether or not you should upgrade your PC, there's almost no circumstance under which you shouldn't. So if it feels right, give it a try. Things will definitely get better! **mm**

The screenshot shows the CPUID HWMonitor application window. The title bar reads 'CPUID HWMonitor'. The menu bar includes 'File', 'View', 'Tools', and 'Help'. The main window displays a tree view of system sensors with a table of values, minimums, and maximums. The sensors are categorized by hardware components.

Sensor	Value	Min	Max
JAMES-PC			
ASUSTeK Computer INC. P8H...			
Intel Core i5 2500K			
Voltages			
VID	0.941 V	0.926 V	1.286 V
Temperatures			
Powers			
Clocks			
Core #0	1605 MHz	1605 MHz	3711 MHz
Core #1	1605 MHz	1605 MHz	3612 MHz
Core #2	1605 MHz	1605 MHz	3612 MHz
Core #3	1605 MHz	1605 MHz	3612 MHz
Utilizations			
UC	6 %	1 %	51 %
WDC WD10EALX-009BA0 ...			
Temperatures			
Assembly	36 °C (96 °F)	36 °C (96 °F)	36 °C (96 °F)
AMD Radeon HD 7700 Series			
Voltages			
VINO	0.825 V	0.825 V	1.100 V
Temperatures			
TMPIND	36 °C (96 °F)	36 °C (96 °F)	37 °C (98 °F)

^ Find out how things are ticking over with CPUID's software



Easy Gaming Upgrades

Giving your PC some extra power doesn't have to be difficult, as this little show...

Keeping up with gaming is a difficult task. You can buy a top-of-the-line PC, and within months it's starting to creak under the demands of the latest titles. Buy a mid-level system, and by the time a year has passed, it's practically obsolete! Sometimes it seems like older systems barely have a chance.

But getting a gaming system doesn't mean you have to junk your existing PC and buy a new one. A few smart upgrades can put your system back in the business of playing games. Sometimes you don't even need to replace the hardware, just give it a little maintenance. Either way, if you want to squeeze some extra gaming performance out of your system, we've put together this list of tips, tricks and upgrades you can perform to help rejuvenate an otherwise ailing PC.

1 If You Don't Have A Graphics Card, Add One

The quickest way to turn any system into an instant gaming machine is to add a graphics card. On-board GPUs might be cheap, but they're not designed for gaming at any serious level. A separate GPU will, in almost every case, offer a considerable performance improvement on an integrated one.

Any system of reasonable ability – even Core i3s and low-end AMD chips – will become passable gaming systems once you put a graphics card in. While the exact card you buy depends on how much performance the integrated GPU you're using can provide, even older GeForce and Radeons should blow away an on-board chip. Look around the £75-£100 price bracket.

Adding a graphics card isn't even a very difficult procedure when you

buy cards at this end of the market. Powerful GPUs require attention to things like internal cooling and power requirements, but cheaper cards can easily run off all but the most weedy PSUs and rarely get to hot to use.

2 If You Do Have A Graphics Card, Upgrade It

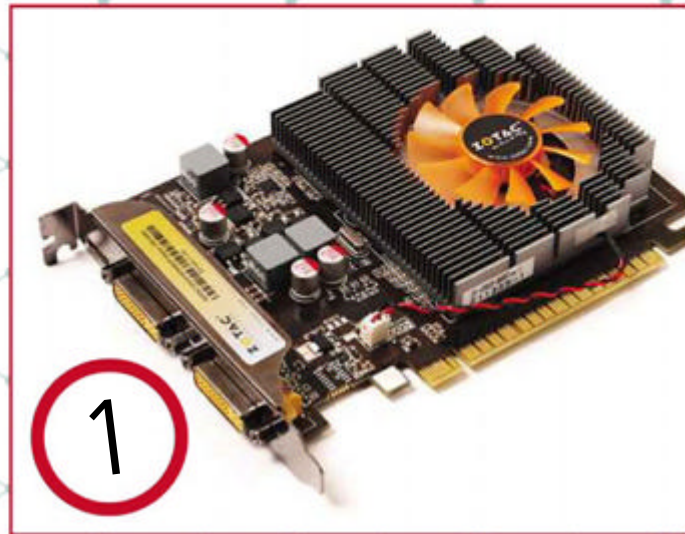
Having a graphics card is one thing, but sometimes the quickest route to improving your gaming is to choose a better one. Modern CPUs are more than capable of meeting the demands games place on them in terms of processing power – it's the visuals that slow your system down.

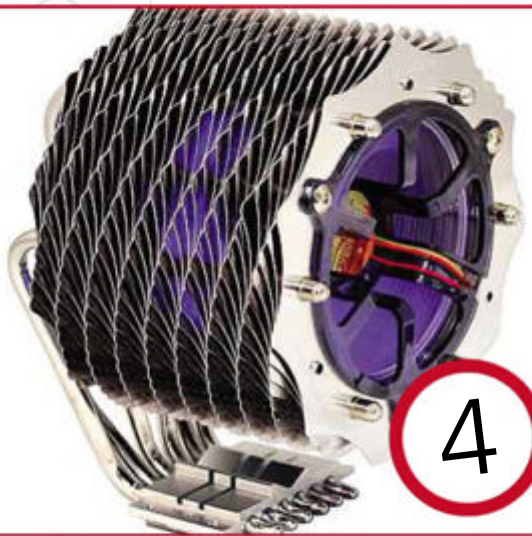
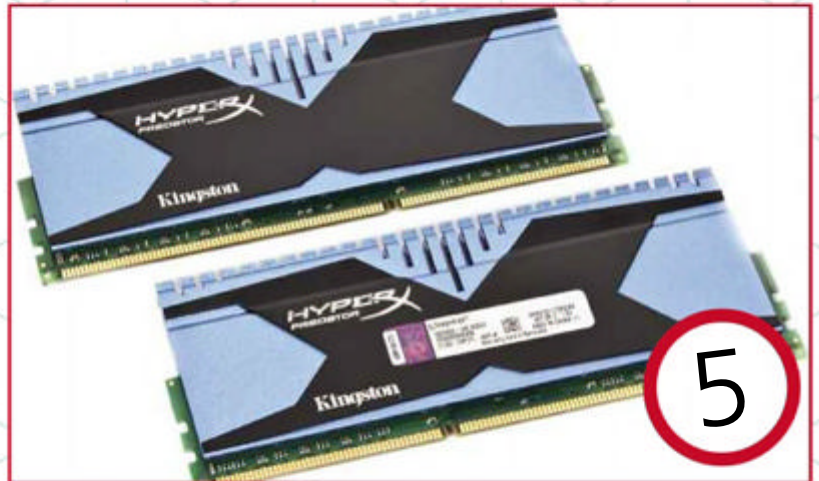
As a rule, if you're upgrading, you want to make sure the model numbers are all higher than your current card. That way you know you're not buying anything slower! RAM amounts aren't such a big deal – GDDR5 is better than DDR3, but more RAM is always better, regardless of speed. Aim for at least 2GB – anything lower is going to be out of date.

As hinted earlier, high-end cards do come with attendant concerns, the most pressing of which is the issue of power. If you have a card that needs its own internal power supply directly from the PSU, check that your existing unit can handle it before you do anything else. A PSU of 500 watts should be enough to run a decent card, but the most high-end may need up to a 700W PSU to be present.

3 Install An SSD

You may not be aware, but a lot of the frame-stutter and pop-in you experience when playing a game isn't caused by an inadequate CPU or slow graphics card; it's caused by the amount of time it takes to





fetch the data from your hard drive and load it into memory. It might be only fractions of a second, but that's enough to make it visible.

This is why SSDs can improve the speed at which your games run. The fast read and write times allow SSDs to shift data around your system faster than any hard drive could hope to, removing the data-transfer bottleneck. Even the slowest, most bog-standard SSD will be exponentially quicker than a standard mechanical hard drive, so as upgrades go they're a guaranteed winner.

Admittedly, there are practical difficulties inherent in an SSD upgrade that might put you off. To get optimal performance from one you'll need to be running Windows off it (since the Windows cache also slows down games), so not only do you have to install an SSD physically; you have to transfer Windows to it and make it your primary drive.

Similarly, the space constraints might also put you off. You might enjoy having a terabyte-class hard drive to install your games on, and having it bumped back down to something measured in gigabytes could be a rude awakening. You can still run your old drive alongside the SSD, of course!

4 Improve Your CPU

A new CPU is always worth considering, not just because it improves in-game performance, but because it improves your system generally. Admittedly, CPUs are rarely the cause of gaming bottlenecks, but if you have a good graphics card and a good SSD, then they're one of the only other definite sources of improvement you can turn to.

Of course, the problem with most chip upgrades is that you're either limited to small improvements within your current generation of chip, or you have to swap a motherboard out as well. A better idea might be to overclock your existing CPU, assuming your hardware supports the ability.

To overclock a chip, you need a K-series CPU (which denotes unlocked speeds in both AMD and Intel chip) and a motherboard capable of taking advantage of this state. There are risks associated with overclocking: the chip runs hotter, which makes it less stable and more prone to damage, so you may need to spend money on a new cooling system to maintain the quality of performance you're accustomed to. It's not a perfect solution, but when the alternative is essentially rebuilding your entire PC from the ground up, this might be a better approach.

5 Add More RAM

The effect of additional RAM on gaming is quite modest in most cases, and beyond a certain point it could even be described as negligible. Most games don't use more than a gigabyte or two of RAM, and instead rely more heavily on the graphics memory over the system memory.

The best time to install more RAM is if you're running an integrated GPU, because then the system memory *is* the graphics memory, and low system RAM can therefore have a negative effect on games. Similarly, if you have such an exceptionally small amount of RAM that your operating system struggles to keep up, another stick or two will improve your gaming performance.

Generally speaking, if you're running a 64-bit version of Windows, you should have 4GB of RAM as the absolute minimum for a functional system. 8GB is the minimum amount you need to run your operating system and games comfortably, so if you have less than that, you probably will see a small improvement in your gaming benchmarks by adding more.

Above that point, the likelihood that more RAM will effect a visible improvement becomes smaller and smaller. 16GB is vastly more than any gaming system needs and is only likely to be of benefit to systems with heavy RAM usage such as media editing systems.

Still, we appreciate that the promise of a RAM upgrade can be tempting; it's easy to install and inexpensive. Just don't let the simplicity fool you into thinking it's definitely worth doing. Spend your money wisely! [mm](#)



Tracking Price Trends

The prices of components can up or down at any time, so how can you predict which way they're going to go and when?

Part of being smart with your upgrades isn't just about buying the right hardware; it's also about making sure you pay the right price. Waiting until the sales is a great way to save money, but that's only useful if there are sales going on. When you're trying to buy in the rest of the year, you have to rely on nothing but the standard prices, whatever they may be.

The thing is, the technology market is hugely vulnerable to price fluctuations. When planning to upgrade, one of the ways you can decide what to buy is by using price trends to figure out which components are currently good value based on their past performance and the general market direction.

Some components, such as CPUs and graphics cards, are generational. Average prices slowly drop until a new version is released, at which point they leap back up. In those cases, all you have to do is keep an eye on what's coming and try not to buy a model the week before they announce street dates for its successor. But the price of most components is heavily governed

by the strength of their particular market, and that can be harder to interpret.

If you've never thought about this before, hopefully the advice we give you will help convey some insight into the factors that affect component prices – and if we help you decide whether or not now's the right time to buy an upgrade you want, even better!

Hard Drives (Mechanical)

Given that there doesn't seem to be any upper ceiling on hard drive size, one of the driving forces behind mechanical drive pricing is their lower limit. The basic manufacturing cost of a hard drive doesn't change as the technology improves, and every couple of years, it becomes such bad value to manufacture drives below a certain size threshold that those drives are done away with completely.

At the moment you'll notice there are increasingly few examples of 3.5" hard drives with a lower capacity than 500GB, simply because anything smaller isn't any cheaper to



make. When it costs as much to manufacture a 100GB drive as it does a 500GB drive, why bother with the former?

Luckily, figuring out the price for a hard drive is easy: simply divide the unit's capacity in gigabytes by its cost to get the gigabytes per pound, and the higher the value the more you're getting for your money. The best-value capacity changes over time, so it's important to do this calculation each time you buy a drive.

The only events that make hard drive prices rise are disasters in hard-drive manufacturing countries, and even then the effect is temporary, with prices levelling back out when the supply chain is re-established. A major flood in 2011 caused prices to leap up, but they had returned to normal less than

18 months later, and this was considered a particularly long return to form.

Hard Drives (SSDs)

Despite having the same purpose as a mechanical hard drive, SSDs are very different devices with different economics. Of course, there's the basic cost of manufacturing, but while the prices of mechanical drives are governed almost entirely on the amount of storage they pack in, SSD pricing relies on a few other factors as well.

One is the type of memory they contain, which may be cheaper or more expensive depending on the brand and/or product line of the drive. The other is the controller, which again, may perform better or worse depending on the drive's age.

One area where SSDs do resemble mechanical hard drives is in their general downward pricing trend. As SSDs get more advanced, the price drops and the capacity of the most expensive drives rises. At present, this happens in small increments, but as with hard drives, it's likely that the leaps will get bigger and bigger over time. The largest SSD drives currently available are 1TB in size, while the best value ones are in the 240GB-320GB class. As with mechanical drives, the low-capacity models (60GB-120GB) are skewed more expensive (per gigabyte) by the basic cost of manufacturing.

Again, SSD pricing trends are unlikely to change unless manufacturing is affected by natural disasters, so you can be fairly sure that the longer you wait, the better the price you'll get. If anything, these trends are even more secure than the ones governing mechanical drive prices, because SSDs are only becoming more popular. There's no danger they they'll become a niche or legacy product any time soon!

RAM

Historically, memory prices have been very vulnerable to fluctuations in the supply and demand of materials. At times, people made themselves rich by correctly speculating on the price of RAM going up or down.

At present, RAM prices are going up, having steadily risen since hitting a low point in December 2012. This applies to all types of DDR3 RAM, though the effect is most pronounced for the current standard (1600MHz memory) and least pronounced in premium memory of 2133MHz and above (which was already expensive). Specifically, the price of 16GB of 1600MHz RAM (2x8GB DIMMS) has doubled since November 2012.

That said, the gradual introduction of DDR4 RAM to the market means that DDR3 prices should level out and then drop as manufacturers and retailers attempt to convince consumers to buy DDR3 rather than wait for DDR4. The lows of 2012 are

unlikely to be seen again, but it'd be a surprise if prices went significantly up from here.

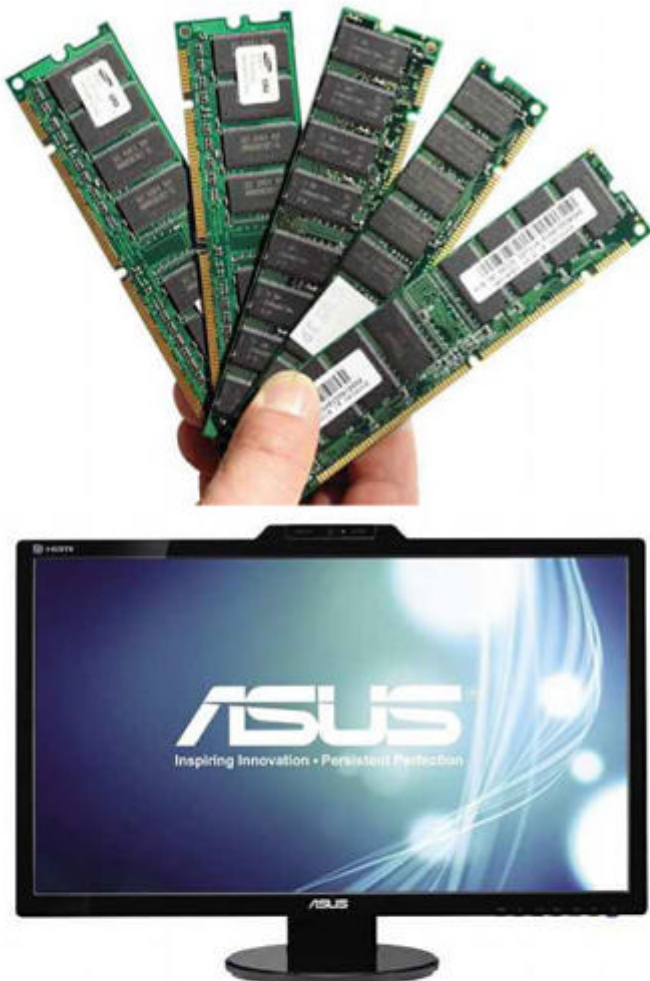
Monitors

Prices in the monitor market have remained almost entirely stable over the last 18 months, with most size and device classes fluctuating up or down by no more than 10% at any given time. There's one notable exception, and that's when it comes to larger, high-end IPS monitors, the prices of which have dropped overall. In particular, the price of the largest IPS monitors (27"-30") has more than halved over the last 24 months, meaning now's a significantly better time to buy one than at any point in the past.

It's likely that most of this drop is due to little more than consumer demand and improved scale of manufacturing as high-end systems become more popular with the public. Increased demand could be considered a reaction to tablets and smartphones – as portable devices get larger screens, owners of more powerful desktop systems find their computers are better suited to large-screen uses (such as home theatre applications and high-end gaming), and the increased demand has directly driven down the price of large monitors.

On the plus side, this does mean that if you're planning to buy a big-screen monitor, you're relatively safe to do so. Price drops aren't likely to happen any time soon, and since they're at their cheapest point since they've existed with almost zero fluctuations, you can be confident that you're getting the best price.

Hopefully, looking at these hardware areas has given you some idea of what affects component pricing and what you can do to stay on top of trends, whether that means snapping a bargain at the right moment or biding your time until the market is looking a little friendlier. It's not easy to guess which direction price trends will go in, but if you get it right, there are huge savings up for grabs. [mm](#)



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Microsoft's Surface 3

David Briddock investigates the new Surface 3 tablet and the demise of Windows RT



For decades, Microsoft has been viewed as a software-only organisation. It relied on other companies to create the hardware to host its operating systems, applications and development tools. Only occasionally did it reveal a Microsoft-branded mouse or other computer accessory.

Today, things are very different. It has decided to push the boundaries of hardware technology by exploiting innovations from its Microsoft Research Labs to build a range of industry-leading products. Examples include the Kinect gaming technology, the upcoming HoloLens augmented-reality headsets, the health and fitness multi-sensor Microsoft Band and its Surface range of Windows tablet/laptop devices.

Surface Success

The launch of the Surface Pro 3 range in 2014, the third incarnation of the Surface platform, pushed all the right buttons for many consumers. As a result, sales soared and devices simply flew off the shelves, causing shortages in quite a few countries on more than one occasion.

Yet despite being a worldwide success story, the Surface Pro 3 models are generally viewed as high-end consumer tablets. Even with recent discounts, the entry-level Surface Pro 3 is £549, plus another £110 for the type cover.

“ It has a fan-less quad-core 1.6GHz Intel Atom x7 processor with a 2.4GHz turbo boost mode and advanced power management ”

Not everyone is able or willing to pay this premium tablet price, despite the Pro's power and flexibility – especially when there are a selection of competitively priced Windows tablets to choose from.

Microsoft is, of course, well aware of this problem. After all, this is the market the now discontinued Surface RT models were supposed to capture (more on this subject later). But now there's an all new member of the Surface family.

Surface 3 Launch

At the beginning of April, Microsoft announced the Surface 3, its new entry point device to compliment the Pro 3 range.

The case is made from the same strong magnesium alloy. It has a high-resolution

touchscreen, 8MP rear-facing and 3.2MP front-facing cameras, a full-size USB 3.0 port, a Mini DisplayPort, a micro-SD card reader, a raft of sensors and a ten-hour battery. Wireless communication includes wi-fi 802.11 a/b/g/n/ac, plus Bluetooth 4.0, and there's even a SIM-enabled 4G LTE version.

So how has Microsoft been able to undercut the prices of the Pro 3 models?

Surface 3 Features

Firstly, it has a fan-less quad-core 1.6GHz Intel Atom x7 processor rather than a faster but more expensive Intel Core processor.

Even so, this is a high-performance Atom processor with a 2.4GHz turbo boost mode and advanced power management. Most importantly, with Intel inside, a Surface 3 runs

the full version of Windows 8.1 plus every existing and upcoming Windows application, tool or utility.

Secondly, the screen is smaller, at 10.8 inches as opposed to the Pro's 12 inches, although the 1920 x 1280 resolution means it retains the 3:2 aspect ratio.

The fan-less Atom chip and smaller screen means the device is thinner (8.7mm) and lighter (622g) than a Pro 3, yet it's still a rather thick package. Microsoft say this is down to the full-sized USB 3.0 socket, which is huge compared with a micro-USB or the new USB-C.

As for storage, there's a base 64GB SSD plus 2GB RAM model or a 128GB SSD and 4GB RAM option.

Other differences include a three-position stand, rather than the fully adjustable one on the Pro. There's a selection of type cover colours, but now the stylus also comes in four colours. However, the stylus is now a £45 optional extra, but you'll need one to get

the most from Microsoft's OneNote, Adobe's Photoshop and Illustrator or the StaffPad music composition app (goo.gl/pnMAHU).

Goodbye Windows RT

As we've seen, the Surface 3 runs the full version of Windows, yet you may recall Microsoft's previous entry-level Surface devices ran something called Windows RT. This is because the Surface RT devices used a lower-cost ARM chip rather than an x86-compatible Intel processor.

However, the problem with Windows RT apps is that they have to be recompiled specifically for the ARM platform. And, in the end, not enough of these RT-flavour apps became available, so despite a significant cost advantage, a Surface RT consumer ended up with a far less practical computing device.

With the introduction of the Surface 3, we can be assured the Windows RT experiment is over. This particular operating system is now obsolete – a direction

many observers predicted when Microsoft announced a trade-in deal for older Surface RT and Surface Pro models.

Now it's Windows 8.1 for everyone, with a free upgrade to Windows 10 when it appears later this year.

The Right Price?

The Surface 3 is priced at £420 (\$499). Just like the Surface Pro models, the type cover keyboard is not included, but this time the stylus isn't included either. Buy both and you'll need to reach into your pocket for another £155.

But remember, the Surface 3 is able to run the full version of 64-bit Windows and any Windows-compatible application. With a type cover, it becomes an affordable and lightweight alternative to a laptop. And it's far more flexible than a similarly priced Apple iPad.

Even better, the release of Windows 10 isn't far away. Not only can Surface 3 owners upgrade for free, but Windows 10 will have Microsoft Office pre-installed, the Cortana personal assistant, the new Spartan web browser, Xbox gaming and much more.

In addition, Surface 3 owners receive a free one-year subscription to Office 365 Personal (including full versions of Word, Excel, PowerPoint, Outlook and OneNote), as well as an impressive 1TB of OneDrive storage. There are a few useful pre-installed apps too, like Drawboard PDF (goo.gl/82EB2U).

One of the key questions is whether Microsoft will offer a student discount. This would certainly help educational establishments and parents seeking to equip their offspring with a flexible and powerful computing platform – although they'll still need to purchase a type cover and stylus.

May Launch, But Try Now

The Surface 3 start shipping on 5th May and will be available in 26 markets just a few days later. However, go to a Microsoft Store today and you can try the Surface 3 for yourself. And if you like what you see, you can pre-order on the microsoftstore.com website or via selected retailers.

Will the Surface 3 be a success? For some the price may still be a little high, but taken as a total package it offers value for money. Plus it's a far more flexible option than a similarly priced Apple iPad.

So it looks as if it could perhaps sell well. And when Black Friday comes around this year, you'll probably be able to purchase a Surface 3 with bundled stylus and type cover for under £500. [mm](#)

“ With the introduction of the Surface 3, we can be assured the Windows RT experiment is over ”





Component Watch

Looking to quieten down a PC? Why not try one of these PSUs?

As tablets have made us used to the idea that computing doesn't have to be a noisy affair soundtrack by whirring fans, we thought it'd be interesting to take a look at how you might be able to run your desktop system with as little noise as possible. So, whether you're building an HTPC and don't want your movies drowned out, or if you just want to get rid of the persistent hum of fans from your work environment, this week we're serving up a helping of the best silent and near-silent PSUs on the market.

Deal 1: Seasonic SS-400ET RRP: £50 / Deal Price: £39

It's not quite fanless, but the Seasonic SS-400ET 400 watt PSU has super-low noise fan controls, 80 Plus Bronze levels of efficiency and high grade components to minimise electrical whine and power fluctuations while in use. Short circuit protection and support for the latest Intel and AMD technologies means this PSU can turn its hand to just about anything you need it to do – and should, anything go wrong, there's a year's warranty included with it as standard. A great starting point, we reckon – and at less than half the price of all the other options, kinder on the wallet too. Where to get it: **Scan** (bit.ly/1CWuvKd)



Deal 2: XFX XTS (460W) RRP: £102 / Deal Price: £91

Certified 80 Plus Platinum, which mean the XFX XTS achieves near-perfect efficiency, means that every penny you spend pumping power into this PSU is going towards driving the components connected to it rather than being wasted in heat and noise. A special double-sided PCB reduces internal wiring to help eliminate heat retention and keep the temperatures down, while fully modular cabling allows you to achieve a similar effect in the rest of your system. If you need more than 400 watts to power your system, this PSU won't be beaten on price.

Where to get it: **CCL** (bit.ly/1BNciRN)



Deal 3: Silverstone Nightjar (400W)

RRP: £105 / Deal Price: £100

Using server-level components and advanced technical design, the ST40NF achieves a high reliability and efficiency earning it 80 Plus Bronze certification. Coupled with single PCI-E 8-pin connector and dual PCI-E 6-pin connectors, the ST40NF can also support high-end graphics cards if needed. It's ideal for HTPC enthusiasts and audio/video professionals, and although it isn't modular it's worth pointing out that it does support SLI/CrossFire setups, which the similarly-priced XFX XTS doesn't!

Where to get it: **Overclockers** (bit.ly/1BNc7Wx)



Deal 4: FSP Aurum (650W)

RRP: £95 / Deal Price: £89

Most fanless PSUs look a bit drab, so if you're after one that's going to give aesthetic appeal as well as silent running, the FSP Aurum is the one for you. As well as a stable 650W output and 80 Plus Gold certification, it has a hybrid-rail design for the most stable power output possible. You're partly paying for the looks, but when others fail so badly at getting them right, it's not a hard decision!

Where to get it: **CCL** (bit.ly/1NbxCr)



Deal 5: Seasonic SS-520FL2 (520W)

RRP: £130 / Deal Price: £121

You won't find a more powerful fanless PSU, but the 520 watt Seasonic SS-520FL2 has more than raw power going for it. A patented fully modular design and 80 Plus Platinum certification helps maximise efficiency and cooling to enhance overall system performance and reliability. Its Japanese aluminium capacitors are good at up to 105°C, meaning there's no chance that this PSU will succumb to heat damage, while its super-powerful 43-amp 12 volt rail is powerful and stable enough for even the most demanding purposes. Easily one of the top fanless PSUs around.

Where to get it: **Scan** (bit.ly/1ySVGci)

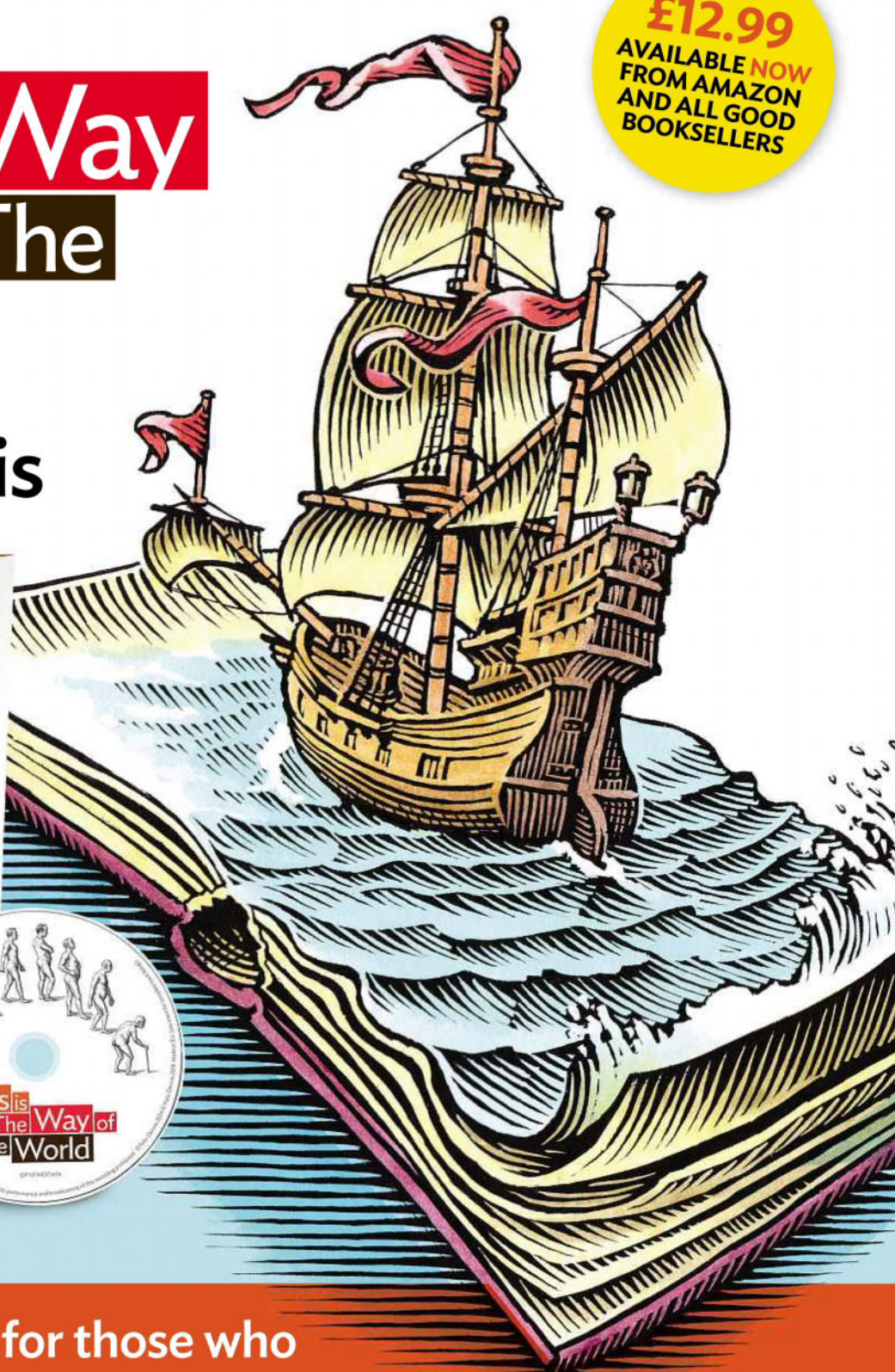
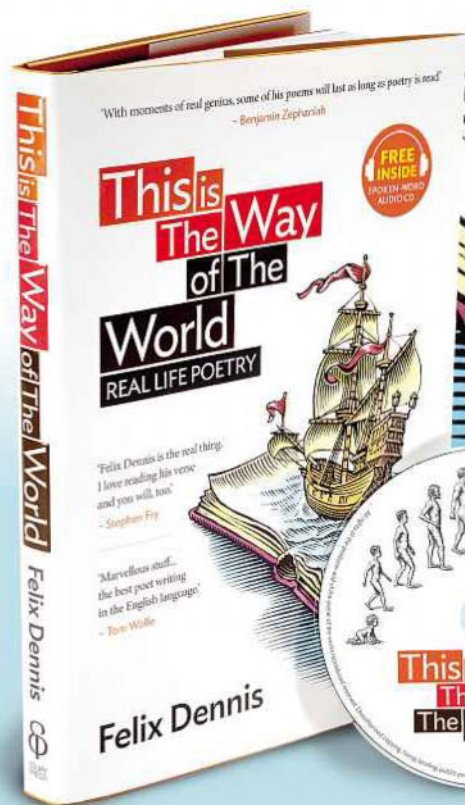


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Google Opens Up Android For All

EE Offers Free Charger For Customers

£20 fee for everyone else

EE customers should pay attention to this slice of news as this is actually a no-brainer of a deal. The firm has announced that it's going to hand out a free portable mobile charger for all customers on monthly mobile and broadband contracts.

The deal will go live on 16 April and the Power Bar will be available to customers who send an SMS to EE for the princely sum of 35p, receiving a code in return. Eagle-eyed readers will note that 35p does not equate to free but then we hope that you don't react as many Facebook users have with outrage and anger at having to pay for a text message for a

charger that's actually worth £20 to non-EE customers (at times, Facebook is just such a ridiculous place to visit).

Anyway, anyone who shows the unique code to any EE store will then be able to pick one up. The Power Bar will work for 500 charges and can be recharged at home or swapped for a fully-charged one in store for free as many times as a customer wants. It comes with a micro-USB lead for charging it up – this will take four hours from flat to full – while an LED torch is also featured on the device.

It's nice to get something back once in a while and if you're an EE customer, we see no reason why not to grab one of these.

Pac-Man Enters Google Maps

April Fools' gag is really rather fun

April Fools Day brought the usual mix of gags, japes and jokes, some quite funny, some decidedly less so. In the not-so-funny pile, how about Sony's PlayStation Flow virtual reality kit, which suggested heading to a nearby swimming pool to share in in-game underwater experiences thanks to a bunch of sensors attached to the body. Yes, this is when April Fools' jokes make pretty much no attempt to disguise the fact that they are blatantly not true.

Google, thankfully, usually gets April Fools' Day just right. Putting to one side the idea of making people laugh, the firm instead set about the frankly genius introduction of Pac-Man to its Google Maps service. In both desktop and mobile forms, the mapping service now lets you play Pac-Man on any

map that you're looking at. So if you want to know what it might be like to play Pac-Man in your local village, now you can do just that. The mobile version of this gag seemed to be centred on specific locations the last time we checked, but the desktop one works anywhere where there are enough roads around to make it worthwhile.

Far more entertaining than a whoopie cushion, a big thanks to Google for putting this one our way.



New tool runs apps on other platforms

Good old Google. The firm has very kindly launched a brand new tool that lets Android apps run on any system using the Chrome web browser. The Arc Welder beta tool has been added to the Chrome

browser to convert Android apps into versions that can then be used with the browser rather than just the Chrome OS.

This means that there's support for Google Play services too (although not all of them), which is a boost for developers

and users alike, bringing potential accessibility for apps within Windows, OSX and Linux systems too. This should all mean that converted apps run smoothly across platforms. If this is the case, it's a potentially massive step forward.



OnLive Shuts Down

Patent sell-off signals end for cloud gaming service

And so we say goodbye to OnLive, the streaming game service that has had – it has to be said – a somewhat turbulent existence. It will now apparently close for good on April 30th after its owners chose to wrap things up and sell a well over a hundred of its patents to Sony, according to the BBC.

The news is not hugely surprising. OnLive had jettisoned many of its staff when sold to a venture capital group in 2012, a necessary move at the time given the company's vast debts and the fact it had failed to gain traction with gamers.

It has also been riddled with technical problems, with many subscribers complaining of poor responsiveness and poor frame rates on some titles. However, this is still a pretty disappointing end for a company and a service that once promised so much. Maybe too much, too soon, as it turns out?

As for Sony, its own interest in the firm's patents is fairly obvious. It wants its own PlayStation Now streaming service to be a success, with the UK beta due to arrive any time soon. Having snapped up patents galore from what was once considered a rival, Sony can move ahead with a spring in its step.



As part of this week's special issue, we've been thinking about ways to repurpose old hardware, rather than binning it or selling it. I've never sold anything on eBay or anything like that, and I don't like throwing things away, so this is something I know a bit about.

Like many of us, I have a box full of components, cables and other bits that I've kept 'just in case'. And as you might have guessed, most of it has remained there, unused.

Occasionally, though, I have found uses for this old gear, like putting an old DVD burner into a caddy and making it into an external unit. Or getting a spare router to work as a wi-fi extender (well, trying to at least).

So before you give up on that old component, just think what it might be useful for first. And if you can't think of anything, maybe keep it anyway. You know, just in case...

See you next time...

Anthony

Editor

Meanwhile... On The Internet...

It's long been prophesied that future wars will be fought on cyber battlegrounds as well as in the physical world (as envisaged by this article from a 2010 edition of *The Economist*: tinyurl.com/Motl1358h), and 2015 may yet be the year that we truly begin to see what that means. Although, as it is with tales of war in countries that seem a long way away, it's easy to become inured to tales of hacks and nation-state cyber-shenanigans (tinyurl.com/Motl1358a), the regularity of the stories and the level of intrusion into our daily lives seems to be continually on the rise (tinyurl.com/Motl1358b).

So not only has this week seen information on China's so-called 'Great Cannon' (tinyurl.com/Motl1358c), a startlingly public statement of intent that appears to explain how the country was involved in targeting GitHub and other sites serving tools to circumvent its great firewall by repurposing rerouting requests to Baidu into DDoS attacks. No, we also got news of hackers with Islamic State links attacking and bringing down France's TV5 television network and social media sites (tinyurl.com/Motl1358d). The latter is undoubtedly the more public-facing incursion: an attack that left 11 TV channels showing only a black screen for a time, and their accompanying websites and social media accounts displaying messages claiming affiliation to IS and the so-called CyberCaliphate, along with alleged information on French military personnel. Nevertheless, it's the tactics of China that are potentially the most worrying going forward. According to a report by the University of Toronto's CitizenLab, University of California at Berkeley and International Computer Science Institute (tinyurl.com/Motl1358g), on the recent China-derived attacks (tinyurl.com/Motl1358e), it's a tactic that could easily be adapted to serve even more nefarious purposes.

Let's you think that we're framing this as a nice-us-vs-nasty-them war of right against wrong, I'll point you to the assessment that China's tactics bear a startling resemblance to the UK/US-funded QUANTUM protocol exposed by Snowden/Greenwald et al a while back (it always leads back to Snowden lately, it would seem: tinyurl.com/Motl1358f). As Nicholas Weaver, a researcher who co-authored the report mentioned above, put it, "The Chinese government can credibly say the United States has done similar things in the past... They can't say we've done large scale DDoS attacks, but the Chinese government can honestly state that the US has modified traffic in-flight to attack and exploit systems."

It also bears pointing out that this is potentially a war with more fronts than we've ever seen before and where we can't even

Facebook has 'fessed up to tracking people who aren't using its social network (tinyurl.com/Motl1358n), but – contrary to a recent report that asserted that it was in breach of European privacy laws (tinyurl.com/Motl1358o) – it doesn't believe it's actually done anything wrong in doing so. In fact, it's gone to the trouble of providing a detailed rebuttal to the accusations (you can read it at tinyurl.com/Motl1358p), which outlines its stance in great detail. Indeed, the report covers so much ground that the Belgian Privacy Commission that produced it has said the company "attributes statements to us that we simply did not make."

Apparently, you see, it's all a misunderstanding; while Facebook did send cookies to some users who were not logged in to Facebook, this was not the company's intention. It's all down to a bug, it says, for which a fix is already in operation. It does, however, make one wonder just how profitable something has to be before it ceases to be apt to describe it as a bug. Call us cynical, if you must.

All this comes at a time when the social network is under increasing scrutiny across Europe. Indeed the Belgian group is one of several currently focusing their spotlights on Facebook's privacy practices. Apparently, Spain and The Netherlands are among a group of countries with an eye on grabbing a tranche of Facebook's considerable coffers for extending its reach beyond the limits of European regulation. Facebook, you suspect, won't admit anything easily.

trust our so-called allies – ask Angela Merkel about that. So it all becomes very frightening when you realise, judging by the recent attacks on Washington-based US administration servers (tinyurl.com/Motl1358i), that Russia is keen to get into the game too (tinyurl.com/Motl1358j). Seriously, this can't end well, can it? You certainly wouldn't think so.

Seeing as we've already covered the 'everything comes back to Snowden these days' thing that seems to be happening in this column at the moment, we may as well sneak in the advice he offered John Oliver on how to select a good password. Clue: yours are probably rubbish (tinyurl.com/Motl1358k).

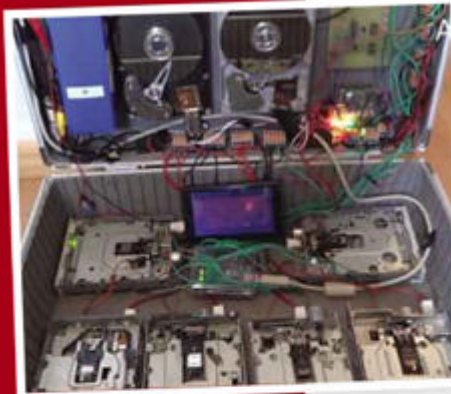
And Finally...

As Netflix has moved steadily away from being a film service and more into a postmodern hybrid of YouTube and HBO, it's interesting to note the effect it's having on the media around it. It's also interesting to look inside the company and see how exactly it deals

with the unique strains of launching flagship shows like *Better Call Saul* and *Daredevil* (tinyurl.com/Motl1358l). After all, no one worries whether the TV network will be able to handle a million extra viewers for Eastenders, do they? Also, it's worth noting how much the service has changed in such a short time; from one that tries to pre-empt what we want to watch (tinyurl.com/Motl1358m) to one that's much more about getting us to go to it. Sometimes the old ways are best, it would seem.

.AVWhy? Videos For Your Eyes... Not Necessarily For Your Brain

The fact that this exists is, frankly, a wonder of the modern age – but with its heart nestled in the increasingly distant past. If there are two things synonymous with our lives in the early 90s, it was floppy disks and Nirvana's *Smells Like Teen Spirit*. That YouTube user Arganalth has chosen to utilise the drives that house the former to play the latter just blows our tiny little minds (youtu.be/G081hD0nWE). *Smells Like An Afternoon In The Uni Computer Suite Followed By Cider And Black In The Student Union* to us.



Caption Competition



"I asked for gorilla glass and these two turned up"

What might these two be chatting about (if chimps could talk, of course)? Let's turn it over to you:

- bigdaddy: "Eat all and sup all: what happened to pay nowt?"
- JayCeeDee: "I don't need a typewriter; I've got Office 365 and the cloud!! A missus is gonna go ape when she finds out!" "Heh, heh, you must have been up to some sort of monkey business!"
- wyliecoyoteuk: "And hehe, ...and then he said... haha... What's wrong with running XP?"
- wyliecoyoteuk: "Apparently, the humans have a site called Reddit, where they measure everything in bananas!"
- doctoryorkie: "You paid how much for an ape-le mac?"
- BullStuff: "So I thought to meself, 'I'll give YOU vivisection, Doc!'... and that's why I'm back on tobacco testing."
- David Attwood: "Do you remember when we used to hurl bananas across town at each other?"
- Brian Jones: "Well, seeing as Jeremy has gone, I'm keeping my arms folded, hee, hee."
- Wudger: "I'm Speak No Evil and you're See No Evil. Whatever happened to Do No Evil?"

Thanks, all, and congratulations to our winner, Thomas Turnbull, with "I asked for gorilla glass and these two turned up."

To enter this week, head to the 'Other Stuff' section of our forum (forum.micromart.co.uk) and say something funny (but not too rude) about the picture below or email us via caption@micromart.co.uk.

Office Lens Now On Android

iOS availability too

Microsoft has taken the welcome decision to bring its Office Lens app to the iPhone and Android.

Office Lens is quite a nifty little app, as Windows Phone users might already be aware of. It basically turns a mobile into a scanner, converting any snapped

images into a Word, PowerPoint or PDF file. The results are editable as a consequence and are stored in OneNote or OneDrive cloud storage.

Simple, effective and highly usable, this move will obviously bring the app in front of more people and will help to raise both it and Microsoft's profile, so a good move all round.

Reach For The Sky...

Pixar's Renderman lets you animate with style

Whether it's *Toy Story*, *Monsters Inc.*, *Up* or *Cars*, pretty much everyone has a favourite, much-loved Pixar movie. Now, however, you produce your own animated can channel your inner Buzz Lightyear as the animation studio has made available its RenderMan rendering software for free, non-commercial use.

This free version, available for download at renderman.pixar.com, has the features of the paid-for version and there are no watermarks or time limits included. As long as you're not going to be using it for commercial purposes it's yours to

use however you like. If you do have a commercial interest, you'll have to pay \$495 for a licence.

If you're at all interested in computer animation, this is a wonderful announcement. Renderman essentially enables projects to benefit from improved lighting effects, among other functionality, and you'll be using the very same rendering software that was used in blockbusters like *The Abyss* and *Jurassic Park*. Wow.

Head for the community site – community.renderman.pixar.com – to see some examples of efforts that Renderman has has a hand in, alongside tutorials and tips.



Snippets!

Sub-15Mbps For 4G

According to Ofcom research, the average 4G speed in the UK is actually down compared against its last set of figures. The data for this research was taken from 120,000 speed tests in Edinburgh, Leeds, London, Newcastle, Poole and Bournemouth and the average speed of 14.7Mbps suggests a lower average speed than that obtained in its tests last November (the average then was 15.1Mbps). Among operators, EE has the fastest average connection at 18.6Mbps while Three performed poorly in comparison at 8.5Mbps.

Trek-Inspired Router

If you have a moment, please head over to the web after you've read this story as you simply must see images of this to believe it. A couple of modders have only gone and put a working router inside a model of the USS Enterprise. Yes, the Starship Enterprise from *Star Trek*. Fascinating...

Reported at various sources on the web, the images of the router are nothing short of brilliant, and you can also hunt down a video of the build over at YouTube – seek for Ubiquiti Enterprise Wi-fi and ye shall find. What are you waiting for – go there now.

7 Still Rules Land Of OS

While Windows 7 is still by far the most popular desktop OS in the world, laying claim to something like 58% of the market, stats from Net Applications tell us that Windows XP remains a surprisingly popular. According to the company, which specialises in Analytics and fraud prevention, it featured on 16.9% of desktops during March, despite the fact that Microsoft ceased support for it back in April 2014.

As for Windows 8 and 8.1, they still only make up 14% of the market – less than XP, the OS that simply refuses to die.

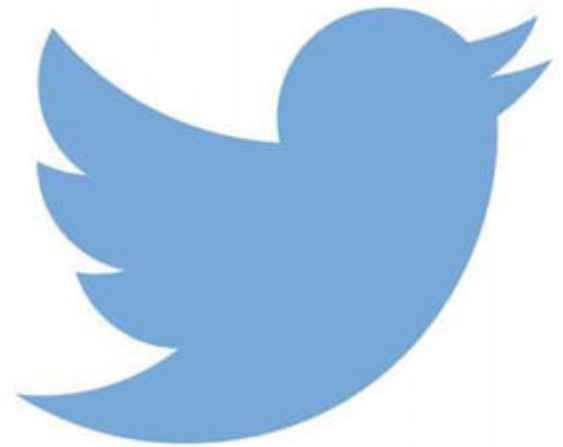
Twitter Rolls Out Quality Filter

Weed out trolls with new feature

The ongoing fight against online abuse continues over at Twitter, with the addition of the Quality filter feature to users of the social media service.

The new feature appears to remove tweets from a user's timeline that are considered to contain threats, offensive or abusive language or are from accounts that Twitter considers to be suspicious. At the time of writing, it's a service that only appeared to be available to verified users, but presumably if it works then it could be rolled out on a wider basis.

When it comes to dealing with online abuse, we welcome anything that might be able to curb it a little.



PC-On-A-Stick From Asus

Intel also launches rival stick

The 'PC-on-a-stick' concept saw its ranks boosted around Easter as a couple of new entries were launched on the market. Google and Asus have combined forces to bring us the Chromebit stick, which promises to deliver Chrome OS to a whole new audience by costing less than \$100. Plugged into any HDMI-enabled display, it will then turn it into a full Chrome OS system. Media reports detail that this is powered by a 1.8GHz quad-core processor, ARM Mali-T760 GPU, 16GB solid state storage, Bluetooth 4, dual-band 801.11ac, wi-fi support, plus a USB 2.0 port.

With the Chromebit reportedly due in the summer, Intel isn't going to let it take all the headlines so it's announced its Compute Stick. Shown off at this year's CES, the Stick also simply plugs into any display and comes

2GB RAM, 32GB storage, an Intel quad-core processor and Windows 8.1. More expensive, at \$149, this is nevertheless another big-name entry into the system-on-a-stick brigade.



New Surface From Microsoft

Thinner. Lighter. Cheaper

Microsoft's Surface tablet hasn't exactly set the world alight. Apple's iPad remains the one to beat and, despite some decent entries into the tablet space, the Surface simply hasn't managed to make as many in-roads into the collective consumer conscience as Microsoft would have liked. Do you know anyone that owns one? Frankly, we don't.

The firm isn't giving up on its tablet aspirations, though, as it's announced a new Surface – the third iteration, in fact. Pitched as “thinner, lighter and even more affordable” than the Surface Pro 3, the tablet has been optimised to run Windows 8.1 and Office 365 Personal (for a year) and comes with a battery life of up to ten hours video playback.

It's powered by a quad-core Intel Atom x7 chip with graphics shown off to maximum impact by a 10.8" ClearType Full HD multi-

touch display with a 3:2 aspect ratio. Audio is catered for with stereo speakers featuring Dolby Audio-enhanced sound and a three-position kickstand means this can be used on a desk, in your palm or sitting down. The two on-board cameras include an

8MP one at the rear and finally, connectivity comes from a full-size USB 3.0 port, Mini DisplayPort, microSD card reader and Micro USB charging port and the cost of all this is... £420. That's the starting price for a 64GB, 2GB RAM wi-fi model. The price isn't

too bad, then, but early reviews don't suggest that this is going to do an awful lot better business than what's gone before.

Still, make up your own mind at www.microsoft.com/Surface-3, where you can pre-order the device for May delivery.





It's **Play Time** In Nottingham

As Nottingham flings open the doors to the National Videogame Arcade, **David Crookes** takes a look at what it has to offer

Back in 2009, I curated a large videogame exhibition inside Urbis, a huge, glass structure in Manchester city centre created to celebrate popular and urban culture. Within months, the building was being turned over to the National Football Museum, the grass being greener and all of that, but the show went on and Videogame Nation visited Woodhorn Museum and Northumberland Archives two years later.

My dream was to produce an interactive, multi-layered history of gaming, going as far back as the 1970s and bringing crowds up to date with the latest technology. For what was stark back then was a realisation that gaming – a massively popular form of entertainment worth billions of pounds each year – was being neglected by the arts world. But if Videogame Nation went some way to addressing that issue, a new venture in Nottingham has pretty much nailed it.

Spread over five floors in the heart of the city is a glass-fronted homage to the gaming industry, which goes by the name of the National Videogame Arcade. It has dispensed with the dimly lit, grubby feel of a real arcade of old, and it has replaced it with an airy collection of rooms, the culmination of which explains the

widest cultural relevance of gaming ever committed to a single building.

It's hard not to walk around the venue without your jaw hitting the floor at the sheer scale of what's on offer. The collections and installations on display are at once creative and educational, taking visitors on a ride through the mechanics of gaming while celebrating it as an art form.

Iain Simons and Jonathan Smith, the co-directors of the NVA, have obviously worked hard to encourage visitors get under the hood of gaming and demystify the development process: "This is the culmination of ten year's work," says Simons. And it's clear they want to inspire people, particularly children, to go home and get stuck in, perhaps learning Scratch or Python on a Raspberry Pi.

That machine features at the NVA, alongside an expected array of age-old computers that range from the BBC Micro to the Commodore Amiga to an entire room devoted to *Donkey Kong*, which includes an original coin-op machine that, as with all of the devices on display, are entirely free to play. There's a ZX Spectrum signed by *Manic Miner* creator Matthew Smith within an entire room devoted to 100 artifacts of gaming from the early days to now. These objects will change regularly to give repeat visitors something fresh to gaze at,

and while there are no attempts to contextualise the objects (they are merely described by name and year), there's no denying they tell a story all by themselves.

Of perhaps more interest, however, are the changing exhibitions, the first of which is Jump! It seeks to explore what has long been a fundamental gameplay mechanic (jumping) and it does so in a variety of ways, either by getting players to leap around on pads in front of large screens running the run-and-jump modern classic *Canabalt* or letting them manipulate a machine called a Jump-o-tron. This rudimentary device lets people control a jump's gravity and physics before inviting visitors to test it by leaping onto another pad. By getting visitors to think about how jumping is used within gameplay, the hope is they will discover its intricate nature.

“ This is the culmination of ten year's work ”

This out-of-the-box approach to showing off gaming comes as no surprise when you learn that the NVA has been produced by the people who run Nottingham's annual

NATIONAL VIDEOGAME ARCADE

1.6 Billion

The number of gamers in the world

£3.9 Billion

Cash spent by gamers in the UK according to the MCV Games Market Valuation Report

2,000

Number of companies creating games in the UK

19,000

Employees in the British gaming industry

33,000

Square feet of the National Videogame Arcade

£547 Million

Amount of cash generated by *Grand Theft Auto*



Some retro history

GameCity festival. The seeds of the Arcade were actually sewn during the 2007 event when Simons announced the launch of the National Videogame Archive, a collaboration between Nottingham Trent University and the National Media Museum in Bradford. Many of those items will be displayed at the museum/art gallery, and that in turn, the organisers hope, will attract more than 60,000 annual visitors and bring £2.5 million to the local economy over the next three years.

GameCity has allowed the NVA to take advantage of many contacts in the industry (the festival has attracted key names from *Oddworld's* Lorne Lanning to *Katamari* developer Keita Takahashi, who was drafted in to produce a kooky playground for Nottingham City Council). It has also brought to the table some very weird and wonderful ideas such as *Room Racers*, a game that was created at the turn of the decade and brings the concept of *Codemasters' Micro Machines* to life, letting you create your own race tracks by placing real items on the floor while an overhead projector beams down virtual, controllable cars, which bump into these objects in real time.

There are other fresh spins on old concepts, one of which can be seen in the Minecraft Room, where

the boundaries between games and the real world are blurred as players stick their head into a dome while projection mapping software works its magic. As the player controls the action using an Xbox 360 controller, it gives a feeling of "being there". This technology was originally intended for use with treadmills in the gym, but its translation to videogaming is inspired.

Again, the belief that games can be played in different ways permeates other exhibits. *Mission Control* created by Alex Roberts mocks up a Nasa-style control centre and claims to turn anybody – even the novice – into a games-maker with a few flicks of a switch and a number of button presses. Two players are able to customise a virtual world in real time on a giant screen while ten others control and fiddle with the gameplay. Smith says that Roberts exemplifies the "incredible team of engineers, developers, craftspeople and crew [who] have come together to build the National Videogame Arcade."

To ensure there is a plentiful supply of such people in the future, there's an educational room where people are able to control games using bananas and other assorted fruit connected to computers. This room will hold beginner classes in



Minecraft Lego

coding using Pis, Flash and Unity. The Arcade will also play host to various talks from major developers, giving up-and-coming game makers an opportunity to discover more about potential careers in gaming. And when they become tired, they will be able to chill out in the LongPlay Lounge, which lets visitors become acquainted with specific games over a longer period of time.

"Videogames are important," says Ian Livingstone, who co-founded Games Workshop and formerly chaired Eidos, which published British classic *Tomb Raider*. "The contribution that videogames make to the UK economy is a matter of record rather than opinion, but it's easy to overlook the part they play as a key element in our cultural lives too. I'm delighted that the wait is over and finally videogames have a cultural home." **mm**



Mark Pickavance examines the many KVM options, as well as the alternatives and why some choices are better than others

Anyone who works with more than one computer rapidly runs into the problem of finding space for everything, thanks to the fact that PCs need a screen, a keyboard and mouse.

That can be super-annoying if you only have limited desk area and/or you need to access the second system only occasionally. You're cramped by equipment you only need to use maybe a couple of times a day, restricting the space you use all day. Surely there's a better way, right? Indeed, there is, and it's called a 'KVM'.

The Original KVM

The abbreviation KVM stands for 'keyboard video and mouse' and is used to describe a gadget that appeared when using PCs as servers first became popular. For many IT managers in this era, often the server hardware was wedged into a broom cupboard or similarly diminutive office space. In these locations, there often wasn't enough room to swing a cat, never mind provide multiple systems each with their own monitors and keyboards.

The first KVMs were frighteningly complicated, being a physical switch that allowed you to cable one monitor and keyboard to two or more computers, through horribly complicated wiring and switch mechanisms.

This was in the 1980s, prior the Windows era, so initially the mouse wasn't part of the problem, as there wasn't any practical use for it, since systems were running Novell Network or DOS.

These devices weren't elegant, but they served their purpose – at least they would when they weren't going wrong or causing problems with the computers.

Having more machines necessitated increasingly intricate wiring and led to a greater likelihood that when you switched, for whatever reason, the target machine wouldn't respond to the newly connected keyboard.

Eventually hardware designs got better, changed from physical switches to electronic ones, and eventually they included PS/2 mouse ports.

Some were even independently powered, in an attempt to reduce

predictable lock-ups. These can occur, because in a PC the keyboard has its own processor that it uses to poll the keys, and if the power is interrupted by the switching action, then the chip reinitialises and synchronisation with the PC can easily be lost.

They also had other restrictions on use, because the length of cable you could realistically extend VGA and a keyboard with wasn't massive, and longer wiring increases the possibility of inherent physical failure. New technologies like DVI, HDMI and USB also added to the number of wires, increasing the complexity and the likelihood of poor connections. So using a KVM could be both wonderful and annoying, depending on what sort of luck you normally experienced.

However, KVM makers did meet those challenges, and you can still buy a hardware KVM today that solves most of these problems.

The Modern KVM

Typically a modern hardware KVM will support USB mice and keyboards, in preference to PS/2, although some will offer a single

port of that type for those that prefer to use it, like gamers.

Where they differ wildly is in respect of the video standards they include, with the cheapest offering to support only VGA displays. The problem with VGA is that it has timing issues with the highest resolutions, and this gets worse the length of the cable that connects the source(s) to the monitor increases. Some cheaper ones only support 1600 x 1200 resolutions, though the best offer 1080p or at least claim to.

More expensive designs support DVI, which is superior in numerous ways, and you can even get HDMI and DisplayPort KVMs if you wish. What isn't generally supported are multiple simultaneous display standards, for numerous reasons, including the hardware detection methods used by the PC.

Some KVMs, specifically targeting home users, support audio, but those aimed at the server environment tend to leave it out, if only to reduce the overall thickness of the cables.

That might seem a minor issue, but even with two computers there are plenty of cables, and when you get to four or more machines, it can rapidly descend into what seems like insulation-covered spaghetti.

The exact number of machines you can switch between using hardware is determined by the depth of your pockets, because above four things can get very pricey indeed. There are KVMs available that support 16, 32 and even 64 machines, but they often cost more than £1,000, due to the complexity of the wiring in them. Even good quality four-port designs using DVI can be more than £200, for those who want to control multiple systems easily.

These directly interfaced solutions aren't the only hardware option. Occasionally, the systems are geographically spread out, and for



those you'll need an even more complicated and expensive device: the KVM switch.

KVM Switches

When I first came across these devices, it resulted in much head scratching about how they offer anything substantially different to cheaper KVM options. But now I understand their function, and it's mostly a range of capabilities that only system administrators would usually appreciate.

What a KVM network switch does is allow admins to access and control multiple machines using existing CAT5

cabling, sending mouse, keyboard, audio and video across the twisted pairs of a LAN cable. This allows for long ranges (50m), although the available video resolution is usually only a maximum of 1280 x 1024. And obviously the connection reduces the performance of that line if you're also using it for networking. To reduce this you can use dedicated CAT5 lines for KVM, although this doubles your network cabling requirement in a single stroke.

The solution to both the resolution and performance problems is to use fibre cabling, usually 10Gbe, allowing sufficient bandwidth for full control plus up to 4K resolution remote displays. The range on fibre is also much better, with 400m being the norm and single system linkage of 10km (yes, kilometres).

With those sorts of capabilities, these solutions are usually more than £2,000, and depending on how many computers you need to access, the combined cabling and switch costs can easily run into tens of thousands.

“ There often wasn't enough room to swing a cat, never mind provide multiple machines each with their own monitors and keyboards ”

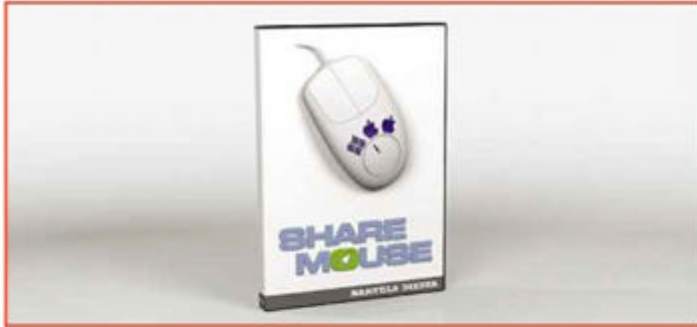
>> Software KVMs <<

Here are some software solutions to the KVM problem that don't include lots of wires or expensive metal boxes.

ShareMouse

Price: Freeware and yearly subscriptions for enhanced versions

Web: www.keyboard-and-mouse-sharing.com



Designed for both Windows and Mac OS X, this easily installed and configured tool can be downloaded from the creator's website. ShareMouse uses a multi-display model, where you simply move the mouse pointer from your computer to the monitors of others, redirecting the input as you go.

There's a freeware version that supports two computers, a Standard edition that adds extra functionality like file drag and drop, and a Pro release that can handle nine computers and up to 16 monitors. The paid-for Standard and Pro releases cost \$19.95 and \$49.95 respectively per year's maintenance, though you can reduce these annual costs if you commit to three- or five-year terms.

One special feature of this tool is that the connection is bi-directional, in that if you have a laptop connected as one of the 'slave' computers, you can use its keyboard to type on the master machine or another slave.

What's best about this, other than the free release, is that any user can easily set it up, because you don't need to know the IPs of your computers to get it working.

LiteManager

Price: Free version and \$10 per seat for full release

Web: www.litemanager.com



This software KVM product was clearly designed as an IT support tool, because many of the features are aimed at helping someone who is having PC problems. There's a built-in chat and messaging mechanism, and it even supports audio and video chat.

What's great for the casual user is that there's totally free version called LiteManager Free that includes most of the important features and can remotely control up to 30 computers at a time.

If you do need some of the special features, like remote device manager manipulation or capturing remote video, then it costs \$10 per controlled computer, with volume discounts when you have more than 50 licences.

You can try the full version for 30 days free if you need convincing that it's worth the extra money.

This isn't as easy as ShareMouse to configure, but it has many clever features that IT managers will appreciate, and it still gets regular updates.

However, the ability to access one PC from another has been an inherent feature of Windows and also Linux for that matter, for some time. It requires no additional hardware, only software configuration, if you're prepared to accept some critical restrictions.

Remote Desktop (RDP)

First introduced with Windows XP, the Remote Desktop Protocol (RDP) is designed to allow one PC to take control of another for the purpose of using applications or remote administration.

The technology Microsoft employed was licensed from Citrix and its WinFrame software client. Citrix improved the underlying technology so RDP gained 24-bit colour support, sound and local resource mapping.



Input Director

Price: Free

Web: www.inputdirector.com



This product has been around a very long time, as proven by its compatibility with Windows 2000, in addition to all the subsequent versions of the OS

It's primarily designed for people who have multiple computers that they want to control with a single mouse and keyboard, but who have each one on their own monitor(s).

Don't be off-put by the last century interface, because what Input Director does is actually very useful, if not as sophisticated as some others. However, it hasn't been updated recently, and some users have reported some glitches to its operation with Windows 8. The last official release was in early 2010, and the last beta release was in September 2012, so that's approaching 'abandonware' in my assessment.

However, it is free, and if you use Windows 7 or even XP, it appears to work admirably.

Synergy

Price: \$10 (single user licence) or free

Web: synergy-project.org



This is a very popular KVM application, and it does a few things that are unique. The biggest selling point is that it's multi-platform, allowing you to move your mouse and keyboard seamlessly from Windows to Linux and Mac OS X, and even share the clipboard between those environments.

Getting it working is generally straightforward, with you installing the keyboard and mouse connected computers as the 'Server' and the others as 'Clients'.

The only fun I noticed was that Mac users need to add '.local' to the end of their computer name when identifying it to other systems.

Unlike Input Director, this is certainly a live project, and the latest version (Synergy 1.6.3) was released on 22nd March 2015, fixing four identified bugs and adding a small enhancement. An earlier stable version of the code, v1.4.18, is available for free, if you want to explore what Synergy can do for you.

Under Windows 7 or 8.x it is a powerful tool that places access to the desktop of another distant PC in a windowed console and allows the user to do the majority of things that they could do locally.

However, there are limitations to what is basically a Windows call interception technology, mostly in respect of its inability to handle anything but 2D desktop graphics. It also can't smoothly stream video being played on a remote PC, because the system isn't designed to handle rapidly changing images.

Those points accepted, it has a number of very useful advantages over hardware KVMs, of whatever cost.

The obvious one is that distance isn't an issue, because with a VPN or

port passing, you can access a PC on the other side of the world using RDP. That makes it popular with IT people who like to work at their desks rather than having to head down to the server room every time a small change is required.

It also allows multiple sessions on the client PC to be initiated, so you can work with a selection of computers at the same time – ideal if you're making synchronised changes

and want to check they're all exactly the same.

Microsoft has also recently released an RDP client for Android, allowing you to use your PC from an Android phone or tablet. It might not be an ideal setup, but the fact you can do it in a pinch is something worth noting.

And because it's an inclusive feature of Windows, that makes it free for those that have that OS.

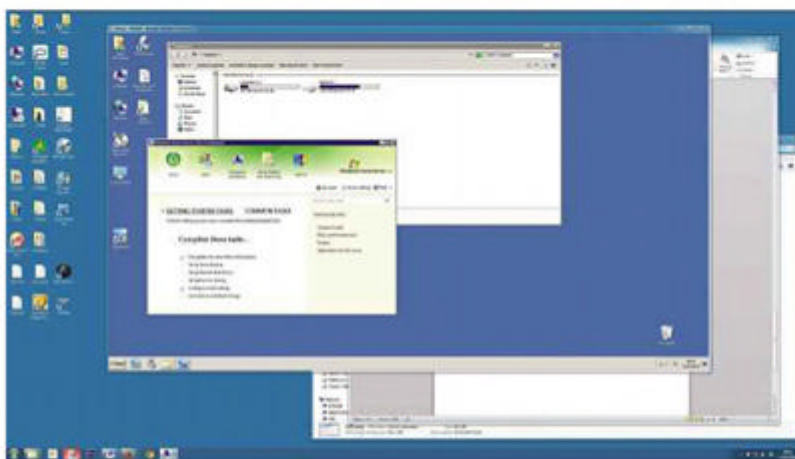
“ The ability to access one PC from another has been an inherent feature of Windows and also Linux, for that matter, for some time ”

As a regular user of this tool I've been impressed with how well it generally works, though by its very nature there are some limitations that can't easily be worked around. Obviously it isn't much use for gaming or even CAD, and you also can't use it to make BIOS modifications, because Windows must be running.

There are also other software solutions that work in a slicker fashion, which might be worth considering.

Software KVMs

RPC isn't unique, and anyone looking for software solutions to the problem of a single mouse and keyboard with many computers will find a wide selection of choices available.



Most of these avoid the biggest problem, that of screen switching, and instead concentrate on the input devices and making that work better.

That isn't the compromise it might sound, because having multiple screens is relatively common these days, and placing a PC on each one controlled by a

>> Hardware KVMs <<

If you don't want to allocate a monitor to your second PC or use the input selection on your monitor, then you might want to try using a hardware KVM. Here are some, ranging from the cheap dual-system solutions to something only IT managers might seriously consider.

StarTech 2 Port Black USB KVM Switch Kit

Price: £37.80

Web: startech.com



The SV211KUSB 2 Port USB KVM by StarTech is designed to operate two PCs with just a single USB mouse and keyboard, and a single VGA monitor.

It comes with all the cables you'll need, although the machines can only be four feet away from the KVM. By keeping the cables short, it's claimed it can handle a resolution of 2048 x 1536 on the VGA, should you have a monitor that runs at that odd pixel ratio.

To switch between systems, you can either push the button on the box or, more elegantly, a hotkey sequence on the keyboard. Sound is also linked through the system, and the cables for that and the VGA monitor are all included.

ATEN 2-port Usb 2.0 DVI KVM Switch

Price: £54.50

Web: www.aten.co.uk



ATEN makes lots of KVM gear, and this is at the low end of its price range. It's a DVI and USB combination, where the cables are integrated to the very small control box. The downside of this arrangement is that should you damage any of the cables, then the whole device is junk.

However, normally DVI on KVM costs more than this, and the system supports 1920 x 1200 resolution switching, using a special DynaSync functionality to stop the PCs changing their display settings while not connected to the monitor.

It does this by storing the monitor's EDID (Extended Display Identification Data) and sending it along to the PC, even when the monitor isn't connected to that PC.

That's clever and so is the ability to double-click the mouse wheel to move from one PC to another.

single set of input devices has many desirable uses.

I've done a breakdown of some of the better known ones, and what's great about many of them is the way that they splice additional PCs into the Windows environment like they're part of one system.

By doing this, the operator no longer has to think about them individually, but instead can use them like he has a massively powerful and parallel system. It also allows games to be played on one screen while other functions are monitored on another, generally seamlessly. When multi-tasking was first vaunted, this is what most IT people imagined it would be like, but using software KVMs it really can be.

Some tools even allow combinations of OS, so you can have three screens all controlled by the same mouse and keyboard, but running Windows, OS X and Linux each.

When you include functionality like the ability to inherently copy files from one desktop to another and even share a clipboard, this can make it the ultimate computing environment.

The only place it generally falls down is when the screen is local, because the machine must be physically close enough for the cables to both reach the monitor. Of course, you can just use a method to send the display over the network – a challenge that isn't impossible to meet.

For many home users either RDP or software KVMs are the way to go, although many IT people still spend thousands on dedicated hardware to do essentially the same job.

Final Thoughts

I'll be honest and say that I've dumped my conventional KVM hardware after many years of using it. Why? Because the cabling was a small nightmare, and occasionally it would malfunction

and lock me out of my work machine. That could be a real problem if I had documents open, as a simple reboot could have highly undesirable consequences. Ironically, the solution to that problem was to use Remote Desktop to shut the system down in a controlled fashion.

For about six months, I've handled running the test rig on its own screen and peripherals, even if it takes up inordinate amounts of desk space.

But I'm about ready to consider switching back, probably to a software based solution with an additional dedicated screen. That should give me the convenience of using only a single mouse and keyboard and allow me to run graphics applications. If it wasn't for the graphics apps, I'd probably stick with Remote Desktop, as it allows you to use the machine with a few well-documented restrictions.

Something slightly odd that I realised when I was working on this article is how those who make wireless mice and keyboards have never considered tweaking them to this purpose. Surely it should be possible to have a mouse and keyboard that could alternate between two or more dongles or, using Bluetooth, allows multiple pairing.

I'm not sure why this hasn't been explored, as it could be a neat selling point, especially for corporate use in server admin and presentations.

The future of the KVM might include that tech, but I also suspect that it will also be entirely software-based, especially when you consider some of the features that Microsoft has been hinting might be in Windows 10.

It's talked about a game streaming capability between machines that would allow a tablet to play a PC game and the Xbox One to play a PC title. If it can achieve these objectives, solving the rendering and lag problems along the way, then this concept will become one that most people understand, not exclusively technologists.

While the reality of these developments is far from clear currently, undoubtedly at some point PCs could become the critical component in gluing many computers and their peripherals together, thus making what hardware you log onto and where ultimately much less important. **mm**

Belkin OmniView Secure 4-Port KVM

Price: £164.13

Web: www.belkin.com/uk



The Omniview range by Belkin includes some very cheap and also some very expensive KVM hardware.

The F1DN104DEA four-port DVI KVM is one of its business-orientated products, and when it was first launched it cost a whopping £259. What's special about it is that there's a secure layer in the hardware that stops any malware using the common connection to bridge between computers that are all connected to it.

I'm not aware that this has ever been a huge problem, but this box stops it ever becoming one.

Probably more useful is support for DVI-D Dual-Link resolution of up to 2560 x 1600, and a rack mountable design. The flip-side of it being so 'secure' is that Belkin decided that hot-keys were potentially a point of access, so the only way to move between systems is using the buttons on the box.

Belkin also makes an eight-port version of this design for those who have £499 to spend on a secure KVM.

Does Change.org Make A Difference?

Sarah looks at the most popular petitions on the site to see what people are signing up to – and whether it matters

Online petitions tend to be regarded with a bit of a sneer. Typing your name into an online form is regarded as the epitome of 'slacktivism', because it makes you feel like you've done something without actually requiring you to, you know, do anything. But can sites like Change.org make a difference?

The Clarkson Fracas

The e-petition site has hit headlines recently because of a campaign to save *Top Gear* presenter Jeremy Clarkson's job. Started by political blogger Guido Fawkes, the petition asked the BBC to reinstate Clarkson, and it gained so much momentum that it became the site's fastest growing petition ever. At the time of writing, it had attracted 1,029,675 signatures and had been personally delivered by a supporter dressed as *Top Gear's* Stig – driving a tank.

That's an impressive display of dedication from fans, but even in the face of people determined enough to drive an actual tank to their offices, the BBC still decided that Clarkson (who, let's not forget, was suspended for punching a producer in the face) would be dropped from the driving program.

We'll have to wait and see whether those million signatures will make a difference, then. But even if it comes to nothing, there'll still be thousands of people signing thousands of other petitions on the site. Let's take a look

at some of the current most popular petitions and see what's getting people riled up...

Cancel Kanye

The current most popular petition right now is addressed to the organisers of Glastonbury Festival. Titled 'Cancel Kanye West's headline slot and get a rock band,' it's another pop culture related petition, started by Neil Lonsdale, a fan of guitar music who's never been to Glastonbury before and would prefer to see The Who rather than Kanye.

As it stands, there are 127,616 signatures on the petition, but its chances of success are pretty much nil. A similar petition aimed at getting Metallica removed from the bill last year failed to get them pulled from the bill, and festival organiser Emily Eavis has written an article for the *Guardian* expressing dismay over online threats and outrage – and her eagerness to see Kanye's set.

Save BBC Three

Yet another pop culture petition, this one is aimed at the Director

The screenshot shows the Change.org website interface. At the top, there's a navigation bar with 'change.org', 'Start a petition', 'Browse', and 'Search'. Below that, the petition title 'BBC: BRING BACK CLARKSON' is displayed, along with the creator 'Guido Fawkes' and location 'United Kingdom'. A large photo of Jeremy Clarkson is featured. To the right, there's a 'Sign this petition' section with a progress bar showing 1,029,675 signatures out of a goal of 1,000,000. Below the photo, there's a text area for the petition: 'We the undersigned petition the BBC to reinstate Jeremy Clarkson. Freedom to fracas. #BringBackClarkson'. At the bottom, there's a 'LETTER TO' section addressed to 'Top Gear The BBC' with the text 'PLEASE REINSTATE JEREMY CLARKSON TO TOP GEAR'.

General of the BBC Trust and asks him to save BBC Three, rather than scrapping it or relegating it to online only. The petition was created by Jono Read, serial campaigner

(and Labour candidate for Holt in the upcoming election), and is backed up with a website and Twitter account to spread the word. As things stand, there are over

282,641 signatures on the petition; whether it'll have any effect on the BBC's decision remains to be seen, as the decision is set to be made in June, followed by a further consultation period. Could it work? The campaign to save 6 Music did, so maybe.

Petitions That Worked

Unconvinced of the potential power of the e-petition? Here are some notable victories Change.org has racked up:

• Don't Execute Meriam Yehya Ibrahim For Being Christian

Another petition with a rather more important aim than keeping a bloke on the telly, this petition was started by Emily Clarke, a law student from the UK, and addressed to the government of Sudan. Meriyam Ibrahim is a doctor from South Sudan who was born into a Muslim family but married a Christian man, for which she was sentenced to death. The petition to have her released and pardoned attracted more than a million signatures, and various world leaders also stepped in. As a result, Ibrahim was released and moved to Italy.

• Keep Rents At A Rate Affordable To Existing Tenants On The New Era Estate

Lindsey Garrett and Barry Watt, tenants living on the New Era Estate in Hoxton, started a Change.org petition to protest a proposed rent hike by the estate's new owners that would have seen tenants – some of whom had lived there for 70 years – priced out of their homes. Almost 350,000 people signed the petition, which was addressed to Boris Johnson and David Cameron as well as the new owners, and even comedian Russell Brand got involved and put his name on the list of supporters. The result was that the estate changed hands again, and the new owners agreed to keep rent at an affordable level for existing tenants.

• Tell USDA To Stop Using Pink Slime In School Food

It sounds like something out of a science-fiction movie, but 'pink slime' is the name given to a kind of low-quality mushed-up beef product, made from scraps and connective tissue. When parent Bettina Siegel learned that the United States Department of Agriculture was planning to use the slime in school lunches, she started a petition against it, and within a day, it had racked up over 100,000 signatures. Within nine days, the USDA had changed its policies and allowed schools to buy meals that didn't contain the food product. The petition closed with 258,869 signatures, but it had achieved its goal in less than a fortnight.

Overturn Asia Bibi's Death Sentence

It feels odd that a campaign to save someone's life is sitting alongside rants about what constitutes real music, but that's the internet for you. This petition is aimed at the government of Pakistan, as well as the British Prime Minister and Foreign Secretary, and asks for a death sentence to be overturned. Asia Bibi, the condemned woman, faces execution on a charge of blasphemy because of some disparaging comments she allegedly made about Islam.

The campaign has almost 570,000 supporters and has attracted attention both in the media and among world leaders, with the Mayor of Paris awarding Asia honorary citizenship if she can get out of Pakistan. The petition starter, Emily Clarke, has had success with similar campaigns in the past, so there's hope that this one will work too.

Sign On The Line

The most signed petitions on Change.org – which is, after all, only one of several e-petition sites on the web – are a bit of a mixed bag, then. On one hand, you have thousands of people putting their names to causes that are ultimately pretty irrelevant. On the other, there are petitions that could genuinely change or save someone's life. And interestingly, the ones that are most likely to work tend to be the more important ones.

Like everything else on the internet, you have need bring a healthy dose of scepticism and consideration to e-petitions. If you want to change something that really matters, though, an online petition might actually be a pretty good way of attracting attention to a cause – and getting the attention of the people with the power to get things done is half the battle. [mm](#)

change.org

Start a petition

Browse

Search

Log in

Petitioning David Cameron, Foreign Secretary Philip Hammond and the Government of Pakistan

Overturn Asia Bibi's death sentence #saveAsiaBibi

Emily Clarke, Westminster, United Kingdom



Five years ago, a mother of five kids in Pakistan named Asia Bibi was sentenced to die for blasphemy.

Asia was alleged to have made disparaging comments about Islam after co-workers objected to her drinking out of their water glasses because of her Christian faith – a charge she has denied. This week, a High Court in Pakistan upheld Asia's death sentence, which means that she now faces execution unless Pakistan's Supreme Court and the global community works to save her.

Join me in asking your government to speak out on behalf of Asia, and help bring the global community together to #SaveAsiaBibi.

Sign this petition

563,000 supporters

Get this petition to reach 1,000,000

First name
Last name
Email
United Kingdom
Street address
Postal code

Minix Neo Z64 Windows 8.1

A small PC packed with plenty of potential

DETAILS

- Price: £130
- Manufacturer: Minix
- Website: goo.gl/Uld88E
- Required spec: HDMI connection (cable included)

We've seen a number of small-form factor PCs recently, from the more traditional Shuttle-looking chassis models through to the newer PC on a stick examples. Clearly there's a need for ultra-small PCs, whether it's for media centres or super-small desktops attached to the backs of a monitors.

The Neo Z64 is the newest entry in the small PC range and comes from Minix. This is an extremely capable unit that features an Intel Z3735F 64-bit processor running at 1.3GHz, 2GB DDR3L memory and 32GB eMMC of flash storage, onto which Minix has pre-installed a copy of Windows 8.1 Bing Edition. The processor used is the same Z3735F that Intel is currently trialling inside its Compute Stick system. It's an energy efficient CPU that delivers a decent amount of processing for normal, day-to-day computing duties. The graphics are handled by an Intel Bay Trail, which runs at 311MHz with a boost frequency of 646MHz.

Further to the above, the Neo Z64 has 802.11n wi-fi, Bluetooth 4.0, a HDMI 1.4 port, 100Mbps Ethernet port, micro-SD card reader and a pair of USB 2.0 ports. All that packed into a device that measures just 115 x 155 x 20mm.



The Neo Z64 is a neat little black box, with Minix debossed into the top of the unit. There's a large wi-fi antennae protruding from the left of the unit, with the HDMI, power, Ethernet and headphone socket at the rear and the two USB ports, a MicroSD card reader and power button located on the right-hand side. It's all very neat, compact and competent.

Booting the Neo Z64 takes mere seconds and, once in Windows 8.1, the desktop is snappy and useable. With about 20GB free on the eMMC flash storage after Windows has taken its share of the space, there's still a bit of room for storage even if you're not connecting other drives.

Naturally, the processor in the Neo isn't going to allow you to play the latest AAA games, but it is capable of running standard office applications and playing HD media content without any hint of a struggle. We tested it on our home network setup and play back from the networked

NAS drive was as perfect as you could wish for.

We were quite impressed by the fact that despite being left powered on for several hours and through play back of the aforementioned HD content, as well as various installations, configuring and updates, the little Neo was barely warm to the touch. We've had a few fanless micro PCs over the years and they all tend to get a little hot under the collar after just a short period of intense processor work. Not so for the Neo, though.

As an under the TV media centre, the Neo Z64 is excellent. It's quiet, reasonably quick and superbly presented. The amount of space left on the drive may not be a huge amount, but considering most users these days store their content on a NAS or some other server, it's more than adequate for Windows, Office and any number of media players or servers. We even found a use for it as a retro emulation PC for under the TV gaming.

Its use as a terminal PC in offices has a lot of potential too, thanks to the low power, low cost and decent performance. At a very reasonable £130 (with the Windows 8.1 Bing Edition license included) there's certainly a lot that can be had from such a small box.

The Minix Neo Z64 is a fantastic micro-PC, that ticks all the right boxes and could offer the average Windows user a far better option than a traditional desktop.

mm David Hayward

An excellent hand-sized PC for general use



QPAD 8K Laser Gaming Mouse

QPad follows up the legendary 5K Laser with a new 8K gaming mouse

DETAILS

- Price: £70
- Manufacturer: QPAD
- Website: tinyurl.com/pken8e6
- Required spec: Vista/7/8.x and USB

My experience, for what it's worth, has shown me that a gaming mouse can be either the very best control device, or the absolute worst. It largely depends on who is using it. However, QPad has tried very hard to make its 8K Laser something that most players (right handed ones, at least) will generally adore. Essentially, this is an updated and enhanced version of the excellent 5K model from last year. Qpad has bounced the sensitivity to 8200 counts per inch, so it now registers seismic events caused by moles digging, and given the mouse an uprated ARM processor, 128KB of memory and RGB controllable LEDs.



This is very much the same mouse, though: it has the same shape, same number and placement of buttons (seven, all programmable), and exactly the same sampling rate of 12,000 FPS. As well as being similar to its 5K Laser stablemate, I also found it remarkably like my favoured old Revoltec Fightmouse Elite. This

allowed me to transition between them with almost no adjustment, once I'd tweaked the settings to make the sensitivity feel similar.

The mouse is slightly lighter than I normally like, at just 112g, but it isn't so light that I can't control it easily. Where I do really like this design is the Omron switches they've used on the two main buttons, which require relatively little force and have a lovely positive click on execution. They're rated for 20 million presses, so the 8K shouldn't break after the first heavy gaming session.

The on-board memory serves to locally store your sensitivity and colour choices that you can make with the QPad Laser Software, onto the device. Once there you can transfer the mouse to another PC and, conveniently, will still operate exactly as it did on yours.

As gaming mice go this is an excellent design, that combines a very natural and comfort-considered shape with lots of sensitivity control and a dash of showmanship. Comparing it to the earlier 5K Laser, the price difference is about £20, which seems a little on the steep side

for what enhancements QPad has added, though.

In terms of the competition it's about the same as the Razer Naga Hex and a tenner more than the Corsair M65 RGB. You can buy cheaper gaming mice from Cougar, CoolerMaster and SteelSeries, but they won't offer the same feature level or build quality.

It's only taken four years to find it, but the QPad 8K Laser is actually the first mouse I've tested that I'd consider retiring my old Revoltec for. Consider that very high praise indeed.

mm Mark Pickavance

Excellent precision gaming mouse with RGB LED lighting

Specifications

- **Sensor technology:** Gaming grade laser sensor
- **Sensitivity:** 200 – 8200 CPI (Counts/inch)
- **Max Acceleration:** 30 G
- **Max Speed:** 3.8m/sec | 150 IPS (inch/sec)
- **Image processing:** 10.8 MPS (Mega pixels/second)
- **USB report rate:** 125, 250, 500, 1000 Hz
- **USB Data format:** 16 bits/axis
- **Buttons:** 7
- **Sensing pixels:** 30x30 pixels
- **Sampling rate:** 12,000 FPS (Frames/second)
- **Cable:** Braided cable 2 meter
- **USB plug:** Gold plated USB
- **Response time:** 1ms
- **MCU Controller unit:** 32-bit ARM M3 72MHz
- **Backlight:** RGB led 16.7 million colours
- **Installation:** Plug & Play
- **On board memory:** 128K
- **Main buttons:** Omron switches. Left / right. 20 million clicks
- **Shape:** Right handed, Ergonomic, five-finger grip
- **Software:** For advanced features and functions



ASRock M8 Barebones Z97 Mini ITX System

ASRock delivers a LAN party barebones for those who crave high performance

DETAILS

- Price: £525
- Manufacturer: ASRock
- Website: www.asrock.com/microsite/m8
- Required spec: LGA 1150 CPU (4th or 5th gen), DDR3 RAM, 1x 3.5" drive or 4x 2.5" hard drives. Model M8 Series (Z97-600W)

Have you ever been to motor show where you see an amazing concept car that is breath-taking, and then the company responsible then actually makes something utterly horrible instead? The M8 is, in many respects the complete opposite of that notion.

Having previously shown off a quite radical design (styled by BMW no less) ASRock then actually went ahead and delivered it. This review model is actually a second generation M8, using a Z97 Express motherboard (which previously offered a LGA1155 Z87 design) and, while we'll accept this isn't visually to everyone's taste, when you get this very heavy (9kg) barebones computer out of the packaging it is certainly a 'wow' moment.

What's difficult to get your head around from the pictures, you see, is the scale; the whole system is just 40cm square and 12.3cm wide, making it a compact solution. In many ways this harks back to the classic Shuttle era, where people tried to fit implausibly hot Intel Prescott CPUs in tiny metal shoe-boxes. Except with the M8, the case is a more feasible size, and the technology the very practical LGA 1150 architecture on a Mini ITX form factor motherboard.

Once you remove the magnetically attached side panels, the inside of the M8 is quite wondrous if you're excited by seeing tons of technology squeezed into relatively tiny spaces. The centrepiece is the custom ASRock Z97-M8 Express motherboard that has been scaled down to occupy minimal space. Yet, it still manages to have six SATA ports, four USB 3.0 ports, Gigabit LAN, eSATA, DisplayPort and HDMI. ASRock even managed to shoehorn in an 802.11ac + Bluetooth 4.0 module and an x16 PCI-E slot, with enough space to mount a 295mm long dual slot video card.

Doing something similar with the old Shuttle boxes was guaranteed to blow the PSU up shortly afterwards, but ASRock

“Having shown off a radical design ASRock then went ahead and delivered it”

got a miniature 600W one made specifically for this system that should handle most single GPU video cards without exploding.

Those budgeting to use the M8 need to consider that they'll also need a LGA1150 CPU, some SO-DIMM DDR3 (up to a maximum of 16GB using 2x 8GB sticks), and a hard drive. There is only room for a single 3.5" mechanism, but that space can be alternatively occupied by up to four 2.5" SSD or hard drives. Optical drive needs are covered with a pre-installed slim Super-

Multi DVD Drive. It's a standard laptop mechanism, so swapping it out for a Blu-ray design is possible at additional cost.

One part that doesn't need much help is the integrated audio, as ASRock used the Creative Sound Core3D DSP, providing EAX 1.0 to 5.0 inclusive and a baker's dozen other audio processing standards. It even chucked a headset amplifier for those headsets that can handle the higher impedance rating of its output. It's all very impressive.





Specifications

- **Colour:** Storm Black
- **Material:** Steel/Aluminium/Plastic
- **Dimension:** 372mm (W) x 123mm (H) x 400mm (L)
- **Motherboard:** Z97-M8
- **CPU:** Supports 5th and 4th Generation Intel Core i7/i5/i3/Xeon/Pentium/Celeron Processors (Socket 1150)
- **Chipset:** Intel Z97
- **Memory:** Supports DDR3 1600/1333/1066 MHz, 2 x SO-DIMM slots, Max. up to 16GB
- **VGA:** Supports 1x Dual-slot Graphics PCI-E Card Max.
- **Supported VGA Dimension:** 295mm x 138mm x 43.5mm.
- **HDD:** Supports 3.5" HDD and 2.5" HDD
- **Optical Drive:** 1x Slim Slot-in Super-Multi Drive
- **Wi-fi:** 2T2R WiFi 802.11 ac + BT v4.0
- **Front I/O:** 4x USB 3.0, 1x Mic, 1x Headphone, 4-in-1 Card reader (SD3.0/MMC/MS/MS PRO)
- **Rear I/O:** 1x 7.1 HD audio with Creative Sound Core3D, 1x Intel Gigabit LAN, 4x USB3.0, 4x USB2.0, 1x eSATA2, 1x DisplayPort, 1x HDMI
- **Cooling:** 2x 70mm fan (Top), 2x 70mm fan (Bottom)
- **Power Supply:** SFX PSU 600W

The M8 like any custom design is a mix of practicality and style, and for the most part it stays impressively balanced. However, there are a few bits of this computer that are compromised, and that any prospective buyers need to be aware of. Getting to the bay where the video card is installed involves taking the top cover off, an exercise that requires you to dismantle a portion of the case. That portion is also where the hard drives are also mounted, unfortunately. It's a tricky task.

Space for mounting a cooler is also very limited, and I'd recommend you find one made for a 1U high rack server instead of installing the Intel stock item. I was surprised that ASRock didn't make its own cooler and integrate it to the metal in chassis for dissipation, logically.

Other than those points, and the limited customisation that you'd expect with this type of barebones, this is a really interesting design that could

“ It's significantly better than most barebones for those that want portability ”

make an exceptionally slick and powerful LAN party rig.

If you factor in the cost of the M8, add an Intel Core i5 4430, 8GB RAM, 256GB SSD storage and medium range video card

then you could be facing a £1000 bill or more. Though that could be tweaked down a little by some astute purchasing, and I'm also confident that the RRP price can easily be bettered for those who can sniff out a deal.

The M8 doesn't offer all the flexibility of a conventional cased PC, but it's significantly better than most barebones for those that want portability and performance in a visually striking, if pricey, package.

mm Mark Pickavance

A stylish and powerful barebones Z97 gaming platform



Edifier MP211 Speaker

A small fully portable and rechargeable Bluetooth speaker, (with extras) from Edifier

DETAILS

- Price: £40
 - Manufacturer: Edifier
 - Website: tinyurl.com/pfuo682
- Required spec:
Bluetooth Audio/3.5
stereo jack.



Since the last time I looked at a portable speaker from Edifier, these devices seem to be popping up everywhere, from adverts in MM, unsolicited mail-shots, even market stalls. Unfortunately a great many of these can only be described as abysmal, producing a tinny rasping noise, rather than anything resembling quality sound. This is due to the inferior components used in their construction, and the price is generally a clue as to the quality you're likely to get, although I believe your ears should always be the best judge.

While this latest speaker (the MP211), certainly can't compete with the likes of similar sized Sonos or Bose products, it's roughly a third of their price. Nevertheless for such a small unit it produces a clear sound, with a reasonable bass quality. It's also great for people on the move, who want more depth of sound than the miniscule speaker on a smart phone produces.

The MP211 is a pocket sized device, measuring 150

x 62 x 31 mm and weighing roughly 180gms, yet for its size it packs quite a punch. The unit is made from sensibly shaped hard plastic, with no sharp corners that could rip your pockets. Also the controls are recessed into the body, to avoid them (or you) getting easily damaged. In fact the operational buttons set into the top are made from a soft rubber like composition; they're quite large and slightly raised, making it easy to operate them by touch.

The unit comes in a range of different colours, and has a built in rechargeable lithium-ion battery that lasts approximately 10 hours. The package also includes a micro USB charging cable, an audio cable with 3.5 jack plugs at each end, and a small lanyard to secure it to your wrist. The input sockets are located on the back; they

include an AUX 3.5 audio socket, which means you can attach it to just about any kind of media player. There's also a micro USB charging port, which is the same as those used on most Android phones, and finally there's a micro SD slot for playing MP3 or WMA sound files from an SD Card, (not supplied).

Like the previous Edifier speaker I looked at, the MP211 is also Bluetooth 4.0 enabled. It operates with an open connection, so you simply select it from your device, hit connect and you're in business. This of course makes it more useful than some of the cheaper units that need to be physically plugged in. There's more, though: the speaker also has a built in microphone, so once it's paired with your phone, it can be used hands free to answer calls. If you get a call while it's connected, whatever's playing will be interrupted and the phone will ring through the speaker. Answering is simply a matter of pressing the phone shaped button on the top. I have to say that both the clarity and volume of the hands free operation is excellent – in fact much better than many of the cheap in-car units.

The output comes from two 38mm neodymium drivers on the front, and a passive radiator at the back which provide the bass tones. I tested it for some time to establish both the range while playing various styles of music, and the battery life. While I only managed 8.5 hours over the course of the review, I'm told that the battery will achieve its full potential after a number of charging cycles. More importantly, perhaps, the sound quality was good regardless of the music genre, and sensibly it will operate nearly at full volume without distortion.

mm Joe Lavery

Offers pretty good sound considering the size and price



Hotline Miami 2: Wrong Number

The ultra-violent and stylish shooter is back for seconds

DETAILS

- Price: £12
- Manufacturer: Dennaton Games
- Website: www.devolverdigital.com
- Required Specs: 1.0Ghz CPU, 1GB RAM, 32MB GPU, 400MB HDD, Windows XP and above

When it first found its way onto our screens, *Hotline Miami* was a bit of a surprise. It comes out of nowhere to be a commercial success – but a very controversial one. The levels of violence involved sparked a lot of criticism, but underneath this gore lay a truly great game, one that was both difficult, yet fair. Although we're sure it's caused its fair share of rage quits in its time, it was always tempting enough to try just one more time. The dark story and slick presentation – along with the pumping soundtrack – only helped with this appeal.

Now we have the long-awaited sequel, as *Hotline Miami 2: Wrong Number* has arrived, once more giving us the change to mindlessly slaughter pixel people in droves with all manner of weapons. On the face of things *HM2* feels almost identical to its predecessor, with the same style, core gameplay, and dark, violent goings on. There's little here to distinguish it from the original, at least at first. On closer inspection, though, you soon realise that this is a more refined game in many ways, and one that's pushed its boundaries in the right way.

It's easy for developers to let enhancement of successful titles get out of control, often making too many changes, so much so that the next game ends



up being ruined. With *HM2*, this isn't the case. Dennaton Games has made clever changes in order to keep the same, addictive gameplay and feel whilst still advancing what's on offer. It's not quite as focused as the first, we'll grant you, but it's bigger and has more variety.

One of the first changes you'll notice is the increase in level size. *HM2*'s missions often take place in larger locations than the first, with some having large, open spaces. This leads to a slower, more methodical pace, as you have to be very careful you don't get picked off by a foe who's just out of view. It can be very daunting, and in truth, some levels push the boundaries of fairness. It's still a good balance of difficulty, though, as this is a game all about trial and error. Levels also use more advanced layouts from the start, such as glass walls

and windows enemies can see through, which didn't make an appearance until much later in the first game. In fact, he whole game is much harder than the first, so don't expect to rush through this, even if you mastered *Hotline Miami*.

The next big change is within the story and character progression. Although the first game featured a single main character, with the second biker character opening up later on, *HM2* has far more – and you're always flitting between them, with each offering different challenges and style. There are simple killers, who follow the same mould as before (for the most part), but there's also a detective, a war veteran, and even a reporter who doesn't kill foes or use guns. Instead he knocks them out and if he picks up guns, he unloads them and throws them away.

The multi-layered story makes the game even more engaging and, thanks to the varied characters, the game also moves between eras. The main story is set during the 90s, but you'll also get chance to revisit the 80s setting, as well as a war zone. Not all characters wear masks either, although some still do, and the stat boosts of these masks make a return.

Other new additions include multiple difficulty levels, as well as a level editor, which should be an excellent inclusion when it's ready (it's still in alpha, and will be released properly at a later date), as it'll make replayability a major plus point as you'll be able to create your own missions and download other peoples, for almost endless options.

Hotline Miami 2 is a slick, well put together sequel that shows a great understanding of how to make the most of the existing gameplay of the first, while still enhancing it with the right amount of new content. It's the same, but it's also refined, and if you enjoyed the difficult and punishing challenge of the first game, this will be a must buy title.

mm Aaron Birch

Expands on the original, but doesn't change the formula too much



Ori And The Blind Forest

A tale of life and death, tree spirits and forest guardians

DETAILS

- Price: £15
- Manufacturer: Moon Studios/Microsoft Studios
- Website: goo.gl/30ttMV
- Required spec: Windows 7 or better, dual core 2.2GHz+, 4GB RAM+, GeForce 240GT/HD 6560+

There have been a few games of late that are just exquisitely put together, *Ori And The Blind Forest* – from Moon Studios in conjunction with Microsoft Studios – is the latest. This really is a delightful and beautifully crafted example of a platform, 'Metroidvania'-type game. The artwork, storyline, musical accompaniment, puzzles, and power-ups speak of a title that has been carefully wrought from the combined skills of the designers and programmers.

After a great storm, a leaf from the Spirit Tree is torn off and finds its way through the forest and into the gentle and nurturing arms of the Naru, a sort of Sloth-like creature. The leaf, now in the real world, then turns into a glowing sprite – the eponymous Ori.

The game starts with a kind of interactive cut-scene, where you occasionally control either Naru or Ori as the beginning of the story unfolds. However, as you'll soon come to realise, the forest is dying and as tragedy strikes Ori once more, you must guide him on a quest to heal the forest and return once more to the Spirit Tree.

Throughout the game, and as Ori evolves into a more capable spirit guardian, there are a number of puzzles that must be overcome to advance to the next stage and to increase Ori's powers. To begin with the



puzzles are, for the most part, reasonably easy and involve you leaping hard to reach places to get a better feel for the controls. Eventually you'll come across Sein, a spirit guide who will help you fight off the evil creatures and hazards that dwell in the forest.

Once you've moved on through the first stage or two, the difficulty level begins to increase significantly, almost fiendishly so, as if the developers want to test your staying power. Although death does come swift at times, you're able to create quick save points throughout the current level, and happily you're never too far from the point where you shuffled your mortal coil.

Graphically, this is a wonderful looking game. The backgrounds, animations, and the characters have real depth and feeling too. It's cartoon like, but not in a sense of something

that's too young – and as you progress the scenery becomes even more spectacular, and Ori's powers increase to enable more freedom of movement and more abilities to explore those areas that previously would have been unavailable.

The gameplay too, as we've mentioned, is cleverly devised and starts to become intense remarkably quickly after the first couple of areas you clear. Also, as you clear an area of the nasties that inhabit it, and as you begin to restore life to those areas, they allow further exploration by offering alternative routes through the level. For example, healing a tree will clear it of the thorns and deadly spores from toadstool looking growths, and it'll clear the polluted water of a pond beneath too, which give you access to swim into caverns and other secret zones. All the while though, you're being



hunted by a giant owl and other such terrible creatures.

There's a glorious soundtrack throughout, which rises and softens as the action heats up and the story unfolds. It serves to complete a package that is blended together wonderfully, bringing highs and lows you don't find so often in a modern game.

Ori And The Blind Forest is certainly a game we'd recommend playing. There's plenty to keep you enthralled, and difficult enough to keep you coming back for more without rage-quitting. And there are times when it hits you hard in the gut, bringing out some deep emotions. **mm David Hayward**

A wonderful game, complete with emotional highs and lows

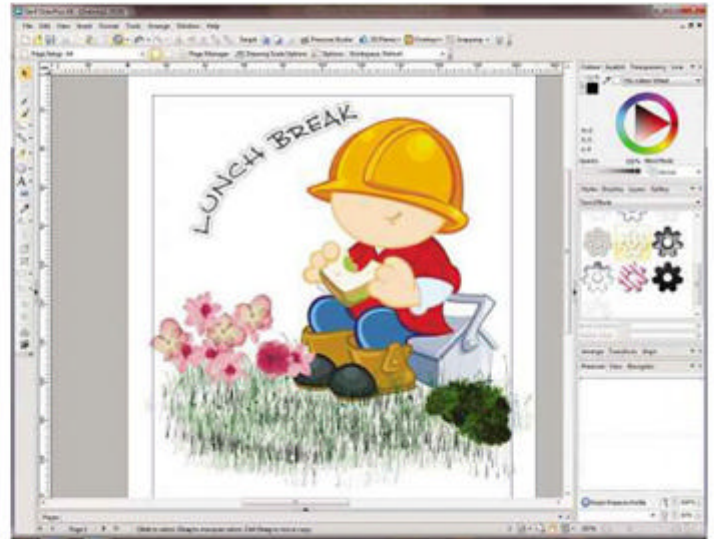


DrawPlus X8

Serif rolls out its latest version of DrawPlus X8 for desktop designers

DETAILS

- Price: £90
- Manufacturer: Serif
- Website: www.serif.com
- Required spec: Windows XP SP3 or better w/ 512MB RAM (more for later/64-bit versions of Windows), 1GB free hard disk for download install



The name DrawPlus pretty much sums up what this product is all about, because it's not your normal illustration program; it's much more than that. Combining traditional vector based drawing tools, with art style brushes, photo editing and animation, it's more like a designer's toolkit. I've mentioned before that companies like Serif regularly roll out new versions of its software, yet not always with enough new content to make an upgrade worthwhile. This is not the case here, because the new additions to DrawPlus X8 are well conceived and seamlessly integrated into the product. Adding many new facilities to what was already a very accomplished product.

If you're unfamiliar with DrawPlus, it's a program you might use to create a logo, design a new fabric pattern, or perhaps sketch out an idea for a project – in fact just about on any occasion where you would normally use pens, pencils, or paints. In that sense it's comparable to Adobe's Illustrator, or Corel Draw – but it can be used without the hefty price that comes with both of those options.

So what's new? Well possibly the most useful of these new features are B-Splines; they provide a much simpler method of drawing curves, particularly

when you're creating flowing designs that need to look natural. You simply draw a line from point to point; the curve is created automatically. If you need to alter it later you can drag the control points that appear at the end of each line when it's selected. (This becomes similar to using the pen tool). To continue from one line to the next is made easy by the fact that they snap together. It's also very intuitive, because it affords you instant visual feedback on screen as you draw.

Staying with lines for the moment, Serif have also improved the precision with this version and introduced hairlines. This is an important addition, particularly if you're creating technical drawings, where you need to vary the width of your lines to improve the clarity of the drawing. I also like the new pressure profile setting. They're designed primarily for graphic tablet users, but without one you can still change the whole dynamic of a drawing, by using one of the pressure profile provided. Basically it varies the width of the line along its length, as you might do when drawing with a pencil by varying the pressure you apply.

Another time saving addition to X8 is the facility to flood fill incomplete shapes or lines. The truth is you don't always want

“ The new additions to DrawPlus X8 are well conceived and seamlessly integrated ”

a border around a shape, or it could be that you want the border to have a different style. In X8 you can do this as Corel has added vector presets with hatching, and an instant vector editor for you to customise the included fills, or to design your own. You can also, of course, use the dozens of brush presets to create all kinds of effects. They include a new range of natural media brushes, emulating watercolour, pastel, charcoal and a sponge brush which is great for smudging existing artwork. Once again these are better employed with a graphic tablet; having said that I got some very nice effects by simply varying the pressure profile.

Finally, Serif has introduced a new Rostrum Slide Show feature in this release. It basically allows you to create animated slide shows from various elements selected on your page. You define the area for each slide, then apply

the timing, animation and transitions. The final show can be exported as a Flash or video file, but I have to say it's a bit long-winded considering the way conventional presentation products work; I also feel it's limited in the effects it offers. Nevertheless, it does the job – and it's an extra feature that Serif has integrated into DrawPlus, so I guess you can't really complain.

mm Joe Lavery

Serif continues to improve and enhance DrawPlus to great effect



GROUP TEST

GoTo Computerised Telescopes

To the purist astronomer a self-aligning GoTo telescope may seem like an expensive indulgence, but we embrace technology, so why not have the best of both worlds?

A GoTo computerised telescope is an amazing device, and when married to a PC and Stellarium, it becomes something more.

David Hayward therefore has one eye to the heavens and the other in front of a laptop, with six GoTo telescopes on test that can be hooked up to a PC.

GoTo Computerised Telescopes

Celestron NexStar 102SLT

DETAILS

- Price: £321
- Manufacturer: Celestron
- Website: goo.gl/k0MziZ
- Required spec: Windows XP or later, serial port or serial to USB adapter, Stellarium

Celestron has quite a reputable history with both amateur and professional astronomers alike. Its products are considered as some of the best available and come in at a decent enough price range for those who want to start looking to the heavens.

The Celestron NexStar 102SLT is a relatively new addition to the NexStar range of telescopes. It's a decent compact unit that's easy to set up and start viewing within half an hour or so from opening the box.

This is a refractor model telescope with an altazimuth mounting and a 102mm aperture, focal length of 660mm and a maximum magnification of around 241x. The tripod is constructed from aluminium, with hand-turn screws to quickly lock the legs in place without the added distraction of trying to not keep on losing nuts and bolts in the dark.

The motor within the mount cradle, located at the top of the tripod, is totally enclosed and stops dust, moisture and other substances that could degrade it over time from ever reaching the vital components within. This is also where you'll need to install eight AA batteries, which we're happy to see are well laid out and easily accessible, with each individual compartment able to be lifted out from the mount for better access.



The 102SLT also comes with an LED red dot finder scope, which is a pretty simple affair but sufficient for manual movements. There are also 25mm and 9mm eyepieces that come as a part of the package, both of which are the standard 1.25" diameter but are of an exceptional quality.

The GoTo technology side of the 102SLT is the NexStar+, which has replaced the older NexStar GT hand control from previous models. As far as a hand control GoTo computer goes, it's very good. With a database of something like 4000 astronomical bodies to choose from you'll be spoiled for choice. However, it's worth mention at this stage that although the 102SLT is a good beginner scope, you certainly won't be able to view all 4000 entries with perfect clarity.

Aligning the 102SLT is extraordinarily easy. All you need to do is point the telescope north,

set the current time and date, followed by as accurate a location as possible. Once set up you'll be able to single out an object, and the GoTo mount will activate the motor to zero in on the object. It's incredibly simple, and you'll also find that due to the build quality of the motor, the telescope will track the object smoothly and without the annoying stepping jarring usually associated with motorised units.

Setting up the GoTo computer with a PC is easy enough, provided you have the right connections to begin with. There are two methods: the first is to use an RS-232-to-USB adapter, with the RS-232 cable leading to the NexStar+ (which looks a little like an RJ11 telephone port), and the second is to use the serial port on your PC – provided it has one.

Using a USB adapter, you can easily upgrade the firmware via the Celestron Firmware Manager, and by assigning a serial port to the connection, you can even use Stellarium to control the motorised mount.

The Celestron NexStar 102SLT is a really good beginner's telescope, and you'll certainly get a clear view of anything you point it at. On the whole, it's perfectly fine for someone who wants to use their PC as a controller while enjoying amateur astronomy and astrophotography.



National Geographic 90/1250mm GoTo Cassegrain Telescope

DETAILS

- Price: £319
- Manufacturer: National Geographic/Bresser
- Website: goo.gl/IgdxLi
- Required spec: Windows Vista or later, serial port or serial to USB adapter



National Geographic has its fingers in a number of scientific, educational pies – so much so that you would come to expect a drop in quality over the huge range of optics, robotics, chemistry and physics products it assigns its name to.

We've often found that some of its mass-produced endeavours lack quality, but that's not the case with the 90/1250mm Cassegrain GoTo Telescope. This is a design that comes a collaboration between National Geographic and Bresser, a company that makes high-quality optics, and it features a 90mm aperture with a 1250mm focal length, giving a maximum magnification of around 180x.

The Maksutov-Cassegrain optical design is very good indeed and compact enough to allow

you to carry the telescope to a location other than the back garden. Portability is also helped thanks to the sturdy aluminium and steel tripod, which can raise

the telescope to a maximum height of around 1.4 metres.

Along with its compact nature and the partnership with National Geographic, this telescope comes with a number of extras. You'll get a pair of 12.5mm and 25mm eyepieces, an LED viewfinder, a star map, moon filter and even a built-in compass. The included CD contains a number of links back to the National Geographic site, along with a basic connection manager to the GoTo controller.

Setting everything up takes about 20 minutes, since it's all self-contained and simple to lock together. However, the GoTo computer took about another half hour to calibrate and get up and running.

While the GoTo control is good, it did have a few peculiarities. For one, we found it often forgot where we were, and when told to locate and track the moon, for example, it would swing the telescope in the opposite direction. There was also the issue that the data on the screen was a little difficult to read at times, primarily because there was so much of it and the fact that words and numbers would be cut off and displayed on the line below with an indent. It's not a huge issue, though, just a mild annoyance and distraction.

Hooking up the telescope to a PC was as easy as the Celestron, provided you already have a serial port on your PC/laptop or you're using a serial-to-USB adapter of some description. Once connected, you can control the telescope with Stellarium (which incidentally fixed the forgotten location issue) and enjoy moving it to notable objects from the comfort of a keyboard and mouse over a digital display.

Despite its ease of use, this National Geographic example isn't the best computerised GoTo telescope we've ever tested. The database of 272,000 objects is impressive, but you'll only be able to clearly see a small percentage of them. On the other hand, the motor, setup and design of the telescope (we especially liked the eyepiece slots in the telescope arm mount) is certainly good enough for a beginner or young person starting in amateur astronomy.



GoTo Computerised Telescopes

Skywatcher Skymax-127 With SynScan AZ GoTo Mount

DETAILS

- Price: £351
- Manufacturer: Skywatcher
- Website: goo.gl/RGvIGN
- Required spec: Windows XP or later, serial port or serial to USB

Skywatcher, like Celestron, is considered one of the best producers of telescopes and other optics. And again like Celestron, its range of products include computerised telescopes for beginners right up to more advanced users or those who specialise in astrophotography.

The Skywatcher Skymax-127 is a beginner's amateur telescope but one that offers a large 127mm aperture, 1500mm focal length and a maximum magnification of 254x. There are a number of models available, each with a different mount, while the telescope itself remains the same.

The model we have on test is the Skymax-127 with SynScan AZ GoTo, an easily set up azimuthal mounting system that incorporates the GoTo controller

into the telescope mount, with the motors all contained within a single neat package.

As with the National Geographic telescope, this is a Maksutov-Cassegrain optical system, a system that combines both mirrors and lenses. Included with the package are a pair of 1.25" 10mm and 25mm eyepieces and LED viewfinder, which doesn't seem like a lot when compared with what

we've already seen. However, it's extremely easy to set up, taking about 15 to 20 minutes in total.

The GoTo controller is a Skywatcher SynScan, complete with 42,900 objects and the ability to connect to a PC and interact with Stellarium through an RS-232-to-USB adapter or straight through to the PC serial port. Setting it up, though, proved to be a bit more of a challenge than the previously reviewed handsets.

The SynScan, although good, needs to be set up with a clear view of the night sky. You can align the telescope with just a couple of stars, but unless you know which star is Mizar or Dubhe, you're going to struggle. And even if you do know the tip of the Plough from Orion's Belt, then you'll also come across the problem that the handset assumes you have an unobstructed 360-degree view of the sky – something that is virtually

impossible in a small townhouse back garden.

However, if you use Stellarium, then it gets a little easier. And once you have the telescope lined up, the GoTo function works exceedingly well. There is, however, the small point of batteries. With a set of eight double-A batteries in place, all fresh, the computer controlled motors last about three hours; that's with viewing, GoTo, tracking and initial setup. If you've got a good clear night and a long session ahead of you for viewing an astronomical event, then there's a good chance you'll run through several packets of batteries before the night is through.

Also, it's worth mentioning that you'll need to set up the GoTo handset every time you remove the batteries. So if you do exhaust your current batteries, you'll then need to change them and recalibrate the telescope. All of this is a bit of a pain and can be difficult in the dark.

Saying that, though, the entire setup is certainly good enough for the beginner, and you'll get some mind-blowing views of the heavens with the large aperture. Using it with PC software is easy enough, and you can always extend the telescope with various attachments as you progress and build your skill levels.



Meade ETX80 GoTo Tabletop System

DETAILS

- Price: £199
- Manufacturer: Meade
- Website: goo.gl/SsZ5ax
- Required spec: Windows Vista or later, DVD drive, serial port or serial to USB

Meade Instruments has a long history of telescopes and other optical devices. Since the early 70s, it has become synonymous with high quality and good value, and in 1999 it introduced the first of the ETX series, ultra-portable, tabletop, computerised telescopes.

The ETX80 is one of the newer lines of tabletop systems and, as the name suggests, this is a telescope that is designed to sit on your patio or garden bench and allow you to view thousands of objects while sitting down and enjoying a cup of tea.

This is an 80mm aperture achromatic refractor telescope, with a focal length of 400mm giving a maximum magnification of 160x. The package includes a pair of 9.7mm and 26mm eyepieces, with a built-in Barlow lens, a compass, telescope base with holes for holding eyepieces and a DVD containing the Meade Autostar Suite and several videos, star charts and so on.

The computerised handset used is a Meade Autostar, which plugs into the motor mount via the HBX port and offers a 30,000 star and object database, a clear readout that details the current position and even a guided tour mode that will move the telescope to various notable objects depending on the location, time and date set in the initial setup.

Along with the built-in functionality of the Autostar, you



The Meade ETX80 GoTo Tabletop System telescope is a reasonably good beginner's setup. The computerised element is excellent, and we really liked the interaction with the Autostar Suite, as well as the ability to remote control and use the telescope beyond the usual computerised handset to Stellarium setup.

The telescope itself is good enough for an amateur astronomer, but it doesn't feel quite as well designed or polished as the Celestron model. Saying that, it is a bit cheaper, at around £199 depending on where you shop. For the sake of starting off in astronomy and due to the fact that it's an incredibly portable setup (we drove out to coast and had it sat on the roof of the car), the ETX80 is certainly one to consider.

“ Doesn't feel quite as well designed or polished as the Celestron ”

can hook up the handset to a PC via the serial to USB or serial port and load up the included Autostar Suite and use the planetarium software to locate and GoTo any heavenly object. In fact, every function you can do on the handset can be controlled through the Autostar Suite, and there's even a function that allows remote control of the telescope over the internet and the ability to translate Autostar text on the

display to synthesised speech on the PC. It's one of the most complete software to hardware packages we've seen.

If you're not comfortable with a tabletop system, the ETX80 comes with an integrated tripod bush that will allow you to mount it on to any standard photographic tripod – although you may need to check the load of the tripod, as the telescope weighs around 4kg.



GoTo Computerised Telescopes

iOptron SmartStar R80

DETAILS

- Price: £345
- Manufacturer: iOptron
- Website: goo.gl/00WtvE
- Required spec: Windows XP or later, serial port or serial to USB

■ Optron is a relatively new company in the field of telescope optics, so it doesn't quite have the reputation behind it that Celestron and Skywatcher enjoy. However, it does produce a few GoTo examples, one of which is the SmartStar R80.

The SmartStar R80 is an 80mm aperture refractor with a 400mm focal length, with a maximum magnification of about 160x. It's a true beginner's telescope, both in design and how it's sold. For starters, it's available in a range of colours: blue, red, lime green and even pink. It's extremely easy to set up, with an almost plug-and-play feel to it. And it's available through a number of outlets, even Walmart if you live in America (although, to be honest, you can probably buy a rifle from a supermarket in the US).

Buying a telescope from Asda-owned supermarkets does involve a certain



amount of caution, and it's quite evident with the SmartStar R80. Although the specifications of the optics are the same as the Meade, the level of detail is pretty poor due to the low-quality eyepieces, which include a 10mm and 25mm. Even with a decent 10mm eyepiece fitted, though, the quality still isn't the same as the Meade and a long way off the Celestron and Skywatcher telescopes.

The computerised element uses a GoToNova iOptron

handset, which offers the user a 3,500 object database, 128 user-defined objects, full backlit buttons and a fairly detailed LCD screen. Getting it to work, though, was a bit of a chore, as the telescope constantly misaligned with the objects it was supposedly pointing at, and on occasion we had to unplug it from the port on the telescope and effectively reboot it again to recalibrate.

Furthermore, when we attempted to hook the telescope up to a PC the

entire setup crashed, taking Stellarium with it. We had to remove the batteries on the telescope and reboot the PC – to initialise the virtual serial port again – before trying again. We did eventually get it work for a short while, but when we tried to activate the motor, the telescope once again refused to communicate.

There are a number of optional extras you can add to the SmartStar R80, though, which include a GPS mount, astrophotography mount and an attachment that allows you to take videos of astronomical events. There's plenty to expand and upgrade to, so it's rather unfortunate that the telescope itself isn't all that good.

On paper, this telescope is a good idea – a beginner's setup that can be upgraded and enable more tools for a dedicated second telescope, for astrophotography perhaps. But with the poor optics, poor iOptron website and, as we've read throughout various forums, poor customer service, we'll be struggling to recommend this. If it was significantly cheaper than the competition, then we might have scored it a little higher, but at around £345, there are far better examples we've already seen.



Orion StarBlast 80mm AutoTracker

DETAILS

- Price: £206 – Telescope and tracker only
- Manufacturer: Orion Telescopes
- Website: goo.gl/KfIMxv
- Required spec: Windows XP or later, serial port or serial to USB, iOS for app

Orion is a company that has been supplying telescopes and other optics to customers since the mid-70s, and it has a long history of excellent customer care, good-quality components and very reasonable pricing.

The StarBlast 80mm AutoTracker is one example of this. This table-mounted 80mm aperture refractor telescope has a focal length of 350mm and a maximum possible magnification of 160x.

This is an interesting setup, when compared to the other tabletop example, the Meade. For one, the AutoTracking is built into the telescope mount and features a basic set of controls that will, as the name suggests, track an object once you've located it in the night sky. Secondly, there are a number of extras included with the package that allow you to attach a DSLR camera and even an L-bracket for attaching your mobile phone. You'll also get a 10mm and 25mm set of eyepieces, LED finder scope and handy star chart.

The AutoTracker, though, is limited in that you'll need to purchase an Orion SynScan controller for the full GoTo computerised effect, a slightly different version than the one used on the Skywatcher



Skymax. Once you've fitted the SynScan, you'll have the ability to look up more than 42,000 objects, tour the best objects based on your time and location, and you'll be able to connect it to a PC via the serial cable (or serial to USB) to use Stellarium.

Furthermore, the Orion SynScan can be controlled remotely with an iPad or iPhone and the Orion StarSeek app. This app not only helps you calibrate the telescope, but can also be used as a mini planetarium when you also include an Orion StarSeek wi-fi module.

Needless to say, there's plenty you can add to this telescope in a kind of modular setup for upgrading as you learn more and become a more advanced user. And of course there's the added benefit that this makes for an excellent astrophotography unit.

The setup of the StarBlast was certainly easy enough, and after we'd hooked up the SynScan controller and wi-fi module, the telescope swung into action within minutes. Plus the fact that it's compact and built to a high standard is very appealing.



The only real issue is the fact that an all-in-one setup does add up when you factor in all the added extras. The telescope itself costs just £206, but the SynScan comes in at nearly £350 and the optional wi-fi is high on £220. With that lot in the basket, you're looking at a total cost of around £770, which is pretty expensive when compared to the other examples we've already looked at.

The Orion StarBlast 80mm AutoTracker is a great tabletop telescope, even when on its own. With the extras it's even better, but the cost will put off most beginners.





Celestron NexStar 102SLT

The Celestron NexStar 102SLT is an ideal computerised telescope for beginners.

The quality is of a high standard, and it's also reasonably priced considering what you get.



Skywatcher Skymax-127

Although the Skywatcher Skymax-127 is the most expensive telescope in the group (although if you added up the individual components of the Orion, then that would take the lead), it does offer as good quality as the Celestron.

There were a couple of niggles, but otherwise an excellent computerised telescope.

How We Tested

Each telescope and the GoTo controller was tested on a Windows 7 laptop, with 8GB of memory and the latest version of Stellarium installed. The laptop also had a serial port, which we tested alongside a serial-to-USB adapter from RS.

	Celestron NexStar 102SLT	National Geographic GoTo Cassegrain Telescope	Skywatcher Skymax-127	Meade ETX80 GoTo Tabletop System	iOptron SmartStar R80	Orion StarBlast 80mm
Price	£321	£319	£351	£199	£345	£206
Telescope Type	Refractor	Catadioptric	Catadioptric	Refractor	Refractor	Refractor
Aperture	102mm	90mm	127mm	80mm	80mm	80mm
Focal Length	660mm	1250mm	1500mm	400mm	400mm	350mm
Max. Magnification	x241	x180	x254	160x	160x	160x
GoTo Object Database	4,000	272,000	42,900	1,400+	3,500	42,000+
Stellarium Compatible?	Yes	Yes	Yes	Yes	Not really, kept crashing	Yes
Other Software	Celestron Firmware Manager	Connection Manager	None	Autostar Suite	None	Orion StarSkeek app
Firmware Upgradable?	Yes	No	Yes	Yes	No	Yes

Your Letters

Why I Use Linux

Further to Tony Hughes letter in issue 1355, I would like to answer this also. A long time ago I wanted to transfer and edit some TV programs from my Humax PVR to DVD. I hasten to add, this was for my personal and private use. The editing was to remove those benighted adverts.

To further this end I went to [a computer fair at] the Motorcycle Museum at Solihull. There I trawled around the various exhibitors until I found somebody who was doing something similar. He was delighted to help: "You will need this program, entry level will do, but I sincerely recommend the pro version. You will also need a good gaming computer!" I replied "How much?" In turn, he replied, looking extremely pleased "Oh, just about £1200!" I asked whether I could use my laptop. "Oh no, no way!" I watched his face fall as I said "If that's the price, then I simply can't afford it!"

However, after a talk with Tom Brock (part-time letter writer to your good selves) I loaded Linux onto my laptop. The list of software other than the OS was:

1. Linuxrw to get the material off the the PVR hard drive
2. ProjectX to correct the constant shift between sound and vision
3. Mplex to stitch the .mp2 and .mv files together again
4. Avidemux to do the editing

It worked just fine on my laptop. I wrote a shell script to help do this. Shell scripting is infinitely easier using Bash than the clunky alternative that windows batch files offer. I should mention that:

1. linuxrw IS available for Windows, I tried it, it repeatedly transferred 2, perhaps 3 files, then crashed. The Linux version simply worked!
 2. projectX is also available for Windows, but back then it did not have the all-important Humax switch.
 3. mplex is not available for windows, as far as I know.
 4. avidemux is also available for Windows, I tried editing a file with it, it gave me an extremely useful file of 0 length
- Why do I use Linux? I like programs that WORK and do not cost an arm and a leg!

LibreOffice 4 is a very good substitute for MS Office.

Dave Hansford

More On Linux

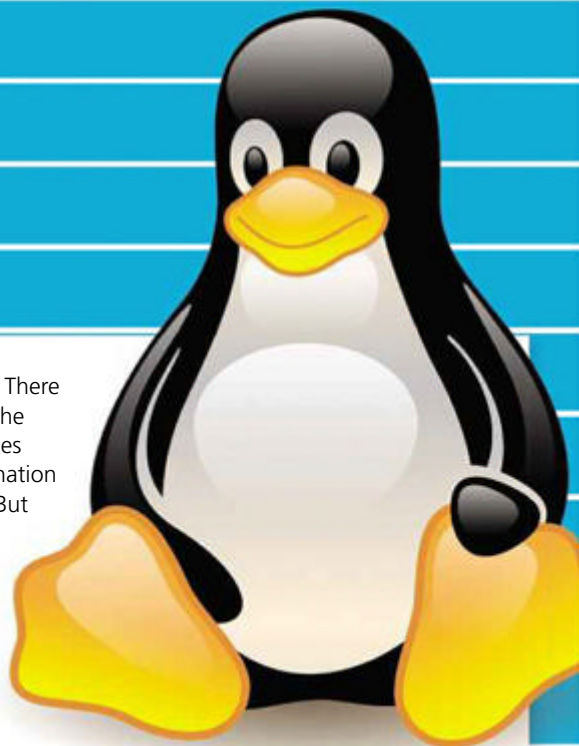
- Your Linux writer David Hayward recently said readers could write in to you to say why we use Linux. Reading between the lines, if nobody responds, that might mean the end of the page? So I'm making sure you get at least one response!
- If it's any consolation, the Linux page is always the very

first page I turn to. There are one or two of the other specialist pages that I have no inclination to even glance at. But there are other people who will be quite the opposite way round, of course – which is probably why your mag has its unique place in the market.

One reason I use Linux is because, when I unfold my laptop on the train or in the bar or library, I enjoy the sidelong glances from the strangers around me wondering what it is I am using. It can be a great conversation opener at times.

Another reason is because, on every one of my computers, I must have a permanently-viewable sidebar of shortcuts down the right hand side of the screen. Such a sidebar gives me always-visible single-click access to any frequently used programs, folders or files I care to put on there – so it is much more than just a 'launcher bar'. My sidebars provide an unbeatable ability to work more efficiently, reliably and speedily.

In the past, you could have such a sidebar easily in Windows 98, XP or Vista, but 'they' arbitrarily withdrew that functionality from Windows 7 and 8 – so I duly withdrew from giving them my future



business and turned to Linux Mint (and, latterly, Linux Mint Mate) where superb sidebars are still supported – and are just as easy to set up as they were in Windows.

So, long may your Linux page continue.

John Smith

GET IN TOUCH...

By email

letters@micromart.co.uk

By post

Micro Mart
30 Cleveland Street
London
W1T 4JD

Online

forum.micromart.co.uk



The Download Directory

James Hunt scours the Internet for the best freeware, shareware and paid-for application releases

Welcome again to the latest instalment of The Download Directory. This month's applications include: Icecream eBook Reader, a desktop ebook organiser supporting all major formats; Image Tuner, a batch image editor for resizing and reformatting images *en masse*; System Ninja, a system tweaking application with loads of capabilities; and Hybrid 2015, an advanced video conversion tool. As well as all that, we've also got the usual look at the latest beta versions to be released in the last month to help you keep track of the new releases which are coming your way soon, and the latest instalment of our regular look back on previous Download Directory entries where we see what happened to the programs of the past and how they've improved – or not.

Icecream Ebook Reader 1.55

Release Type: Freeware

Official Site: icecreamapps.com

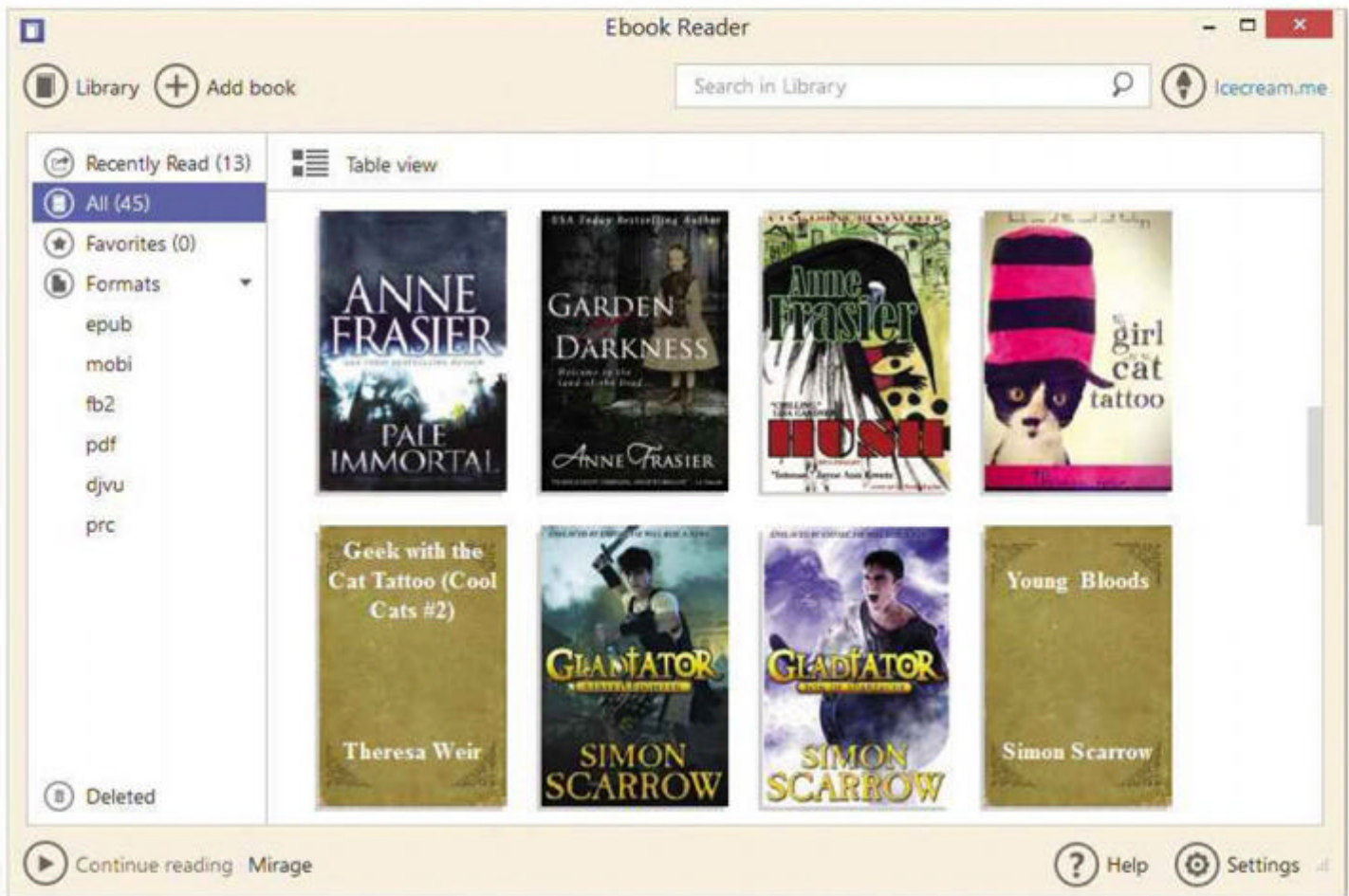
The desktop PC isn't really the natural home of the eBook, which demands a portable screen at the very least. That doesn't mean people never read eBooks on their desktop system, though. Ineed, organising and quickly browsing them is far easier on a desktop

than it is on an eReader. There are several apps out there that allow you to do this, but if you find Calibre too expensive and don't want to be part of the Kindle monoculture, Icecream eBook Reader might be for you. The software can read all major (open) formats, including epub, mobi, cbr, cbz and PDF files.

Unlike other readers, it gives you the ability to open multiple files simultaneously, and maintains a library which you can organise in a number of ways. The standard cover browser is a given, but you can also arrange it to display details, or filtered by text, or even your own tags. Reading the books themselves isn't difficult at all.

Double-clicking a book will open it, and you can use either the mouse or the keyboard for browsing through the pages. It's fairly easy to work out a method you feel most comfortable with, given the number on offer. There's a full-screen mode for distraction-free reading, and you can change the font, zoom in and out and even read in 'night mode' where the colours are flipped to reduce screen glare.

As you'd expect, the app remembers the last page you read and can pick up where you left off whenever you reopen a book. Despite this, there are some weird omissions from the interface



which restrict the app's usefulness, especially as a collection manager. There's no way to select multiple books, for example, so you can't remove more than one at a time. Worse still, there's no shortcut to delete, and every deletion has to be manually confirmed, and even then the books only get put into a recycle bin-style 'deleted' folder, so you then have to go and delete them individually again to get rid of them for real. You're forced to complete at least four operations for every removal you make, so it's hardly streamlined stuff.

Despite that major frustration, it's an otherwise good reader. This is the sort of thing that could be fixed in time, but we're not sure the other features make up for the larger frustration. Reading books is clean, simple and intuitive, but the rest of the app can't live up to that standard. However, given that actually reading your eBooks is probably the last thing you do with them on a desktop, we're not sure the app has its priorities straight.

Pros: Great for reading books

Cons: Terrible for organising them

Rating: 3/5

“ You're forced to complete at least four operations for every removal you make, so it's hardly streamlined stuff ”

Image Tuner 5.3

Release Type: Freeware

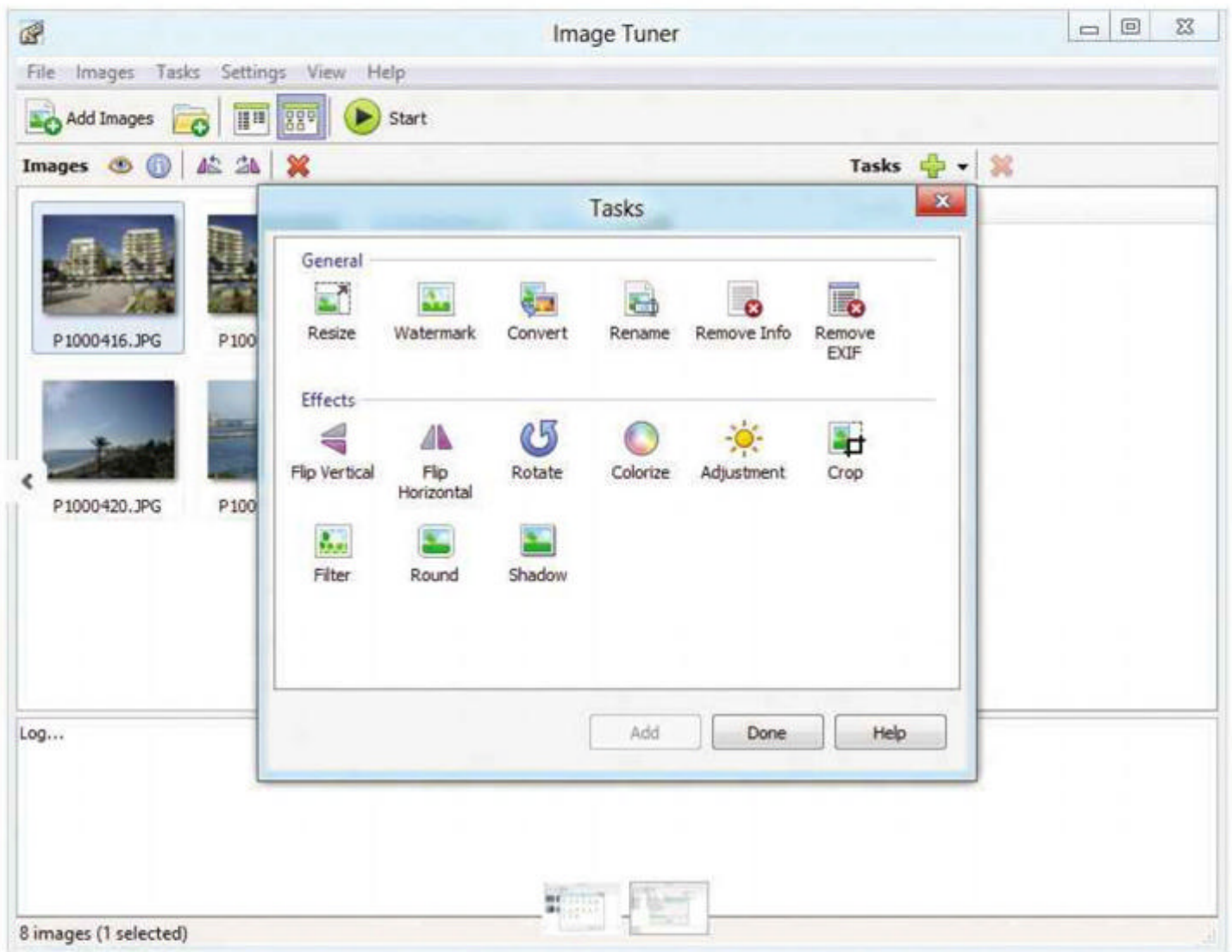
Official Site: www.glorylogic.com

Batch editing photos is always difficult to get right. Either it's a small part of a large suite, which makes it hard to access, or it's the entire purpose of an application and the software goes overboard in giving you too many options about what to do with your images. When we look for a batch-based image editor, we're looking for two things: speed and simplicity. And that's what Image Tuner provides.

Primarily it's the workflow. It takes only a few clicks to get your images in and out as long as you know what you're doing, and you can drag and drop files or entire folders to quickly add them to your project. Presets even help you tailor the image for its destination platform, so if you're viewing them on an iPhone, Twitter or Facebook then it'll alter the resolutions to their optimum size while preserving the correct aspect ratio.

Most batch-editing programs make this sort of thing a chore, so it's heartening to see a program trying to stay one step ahead of you when it comes to determining the dimensions and depth of an image. There's almost no chance you'll end up having to perform the same task twice because it's so easy to get right the first time. Extended features include the ability to select your preferred output format, the ability to rename photos as they're altered and the ability to add a watermark to everything that gets processed.

You can strip out EXIF data, and even apply simple editing and enhancements like flipping, rotating, colourising and sharpening. Support includes everything from RAW camera shots to lossy



formats like GIF and JPG. The software is also tightly engineered to use as little CPU as possible during the conversion process, so you don't get significant slowdown or freezing even when large batches are being worked on. It's simple, powerful, intuitive and compact. As software packages go, it's hard to fault.

Pros: Well-designed for speed and simplicity

Cons: Nothing worth mentioning!

Rating: 5/5

“ Does does it live up to its name then, or are you imagining something a lot more interesting? ”

System Ninja 3.0.6

Release Type: Freeware

Official Site: singularlabs.com/software/system-ninja

It's probably got the most exciting name of any app we've ever reviewed, but don't let that set you up for a disappointment. System Ninja is actually a fairly common class of application

around these parts: a PC management and clean-up tool. Does it live up to its name then, or are you imagining something a lot more interesting? Well, as this type of application goes, it's actually quite good.

There's a built-in junk scanner for quickly listing the standard set of temp files and junk directories so you can remove them if you want, but it also goes a step further and cleans out things most apps don't find, like old log files and ancient backups. It's this approach – being slightly better than the opposition – which serves System Ninja well. Other decluttering tools include a Start-up Manager that roots through your automatically launching programs and helps you remove the ones you don't want; if you see something you think can be removed, then it takes only a couple of clicks to get rid of it for good.

The software also has a built-in list so it can highlight any common items that are safe to remove. Again, it's this extra step that makes the program better than its rivals. It may not be comprehensive, but at least it's trying. One area where it falls a little short is in its cut-down versions of the process manager and uninstall control panel item. Both load quickly, which is good, but neither is up to providing the same level of information as the thing they replace. It'd be preferable if they simply launched the relevant area from within the app using a shortcut. The rest of the tools are great, though. MalRun Destroyer integration helps you locate memory-resident malware, and there are file-

Betawatch

To help you stay on the bleeding edge of software releases, Betawatch is a guide to the experimental and unfinished versions of some of the most popular applications around. Can't wait for new features? Now you don't have to!

Wordpress 4.2 Beta 3

wordpress.org/news/2015/03/wordpress-4-2-beta-3

Wordpress Betas always add an interesting selection of features that you can play with on your site – though for security reasons, it's recommended that they don't be placed on live sites. Still, if you want to test the latest version of the software out you can download and install it now.

New features in the 4.2 beta (not just this version) include a complete revamp of 'Press This' to make sharing content on your blog easier than ever (including a new mobile workflow), easier browsing and switching of themes, and the ability to install plugins in-place from the plugin screens. Wordpress' emoji support has also been expanded, and the software even supports them in post slugs now – which might make for some interesting URLs in the future! Quick edit has been refined so posts can be changed on a smaller screen, and the time has been standardised across multiple login and admit areas. Of course, there are loads of bug-fixes too. Hundreds of them.

You can download, install, and even modify the latest version of once you've downloaded it from the Wordpress site.

follow to reach some features is a bit much if you're not quite sure what you're looking for. It's easy to forgive, though, because almost everything the app does is useful and slightly better than what other applications offer.

Pros: Comprehensive and innovative with lots of ideas

Cons: Not every idea lands

Rating: 5/5

“ It's the extra steps that make the program better than its rivals. It's not comprehensive, but at least it's trying ”

Hybrid 2015

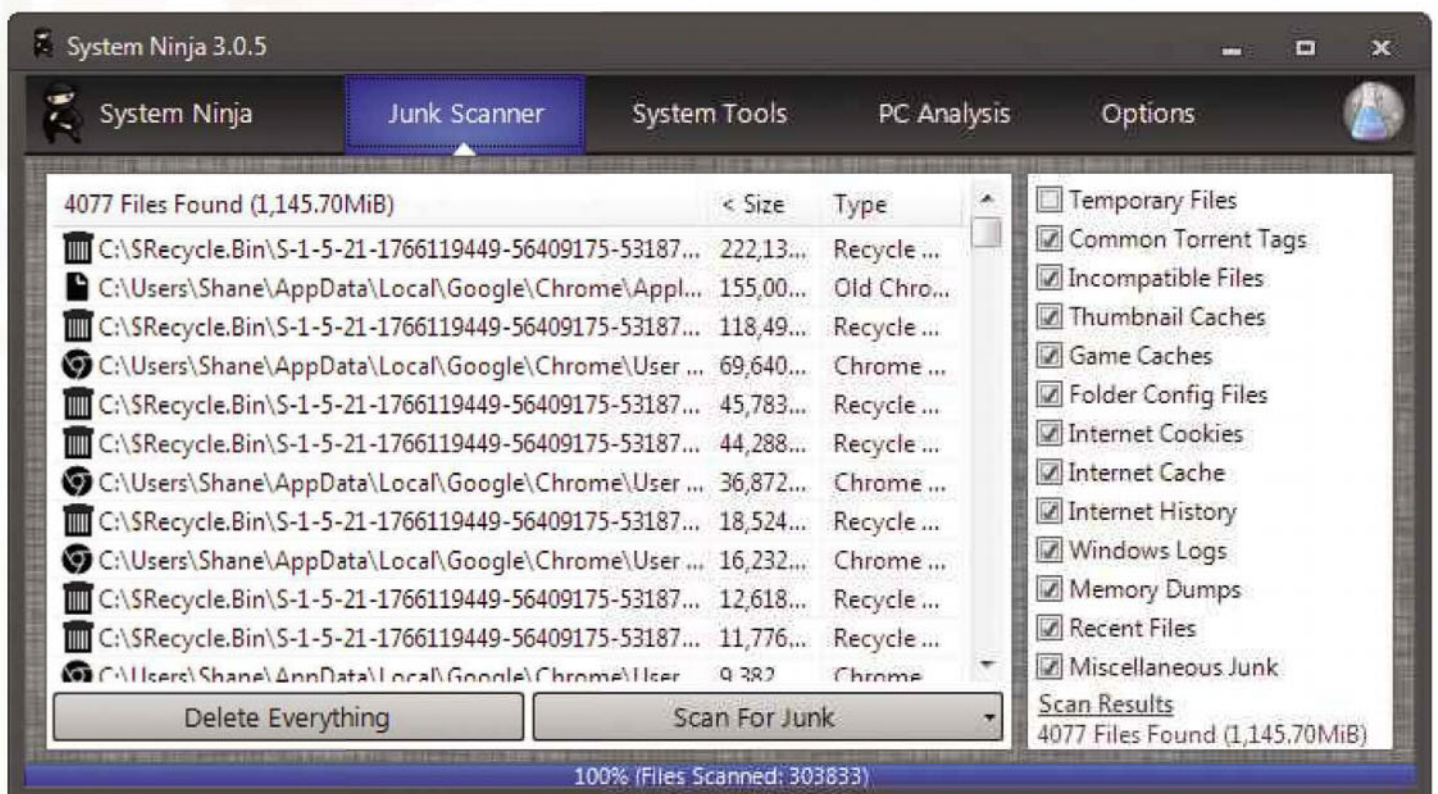
Release Type: Freeware

Official Site: www.selur.de

Converting video between different formats can be a frustrating and sometimes difficult process, so any program that professes to make it easier is a good idea by our standards. Hybrid is designed to do that, supporting conversion through a number of different video formats, but it does sort of trip itself up by being so comprehensive.

Actually, the reality of this is that Hybrid's selling point isn't its simplicity, it's the wide range of options it manages to make available to even the most casual user. If you don't find yourself googling what at least one of the options means here before you start your encoding, then you're either professionally involved in the AV industry, or you'll be finding encoded files has come out wrong somehow. It's clearly aimed at the high-end of video

analysis applets to allow you to do things like run MD5 or SHA1 verification. A selection of plugins include the ability to find duplicates or batch rename files, and the PC analysis area gives you quick access to a list of your installed hardware. It's a genuinely impressive array, all things considered. As is often the case, this many features leads to an interface that sometimes feels a little overstuffed, and the labyrinth of menus you have to



ReDownloaded

This month, in our retrospective section, we're looking back at the April 2013 instalment of Download Directory to see how the programs we reviewed have fared. Are they better? Worse? Gone completely? Let's find out...

AdFender

adfender.com

Reviewed Version: 1.7.5, Current Version: 1.8.3

If you want to block adverts but don't get on with something like Adblock Plus, AdFender was a great alternative when we reviewed it two years ago. It's still plugging away, though slowly (the version update was released in August 2014, and the one before in December 2013), but for a piece of freeware, that's not egregious, and a comprehensive list of new features means it's definitely worth revisiting.

Xpy

sourceforge.net/projects/xpy

Reviewed Version: 1.3.5, Current Version: 1.3.8

We enjoyed this Windows security tool at the time for the way it shored up your registry from unauthorised modification and gave you quick access to OS modifications with its profiles. Clearly it didn't catch on, though. It's barely been touched in the last

year and its official site has disappeared. As the older versions of Windows its targeted at disappear, this was probably inevitable, but it's still a shame that this program didn't land an audience.

Wireshark

www.wireshark.org

Reviewed Version: 1.8.7, Current Version: 1.12.4

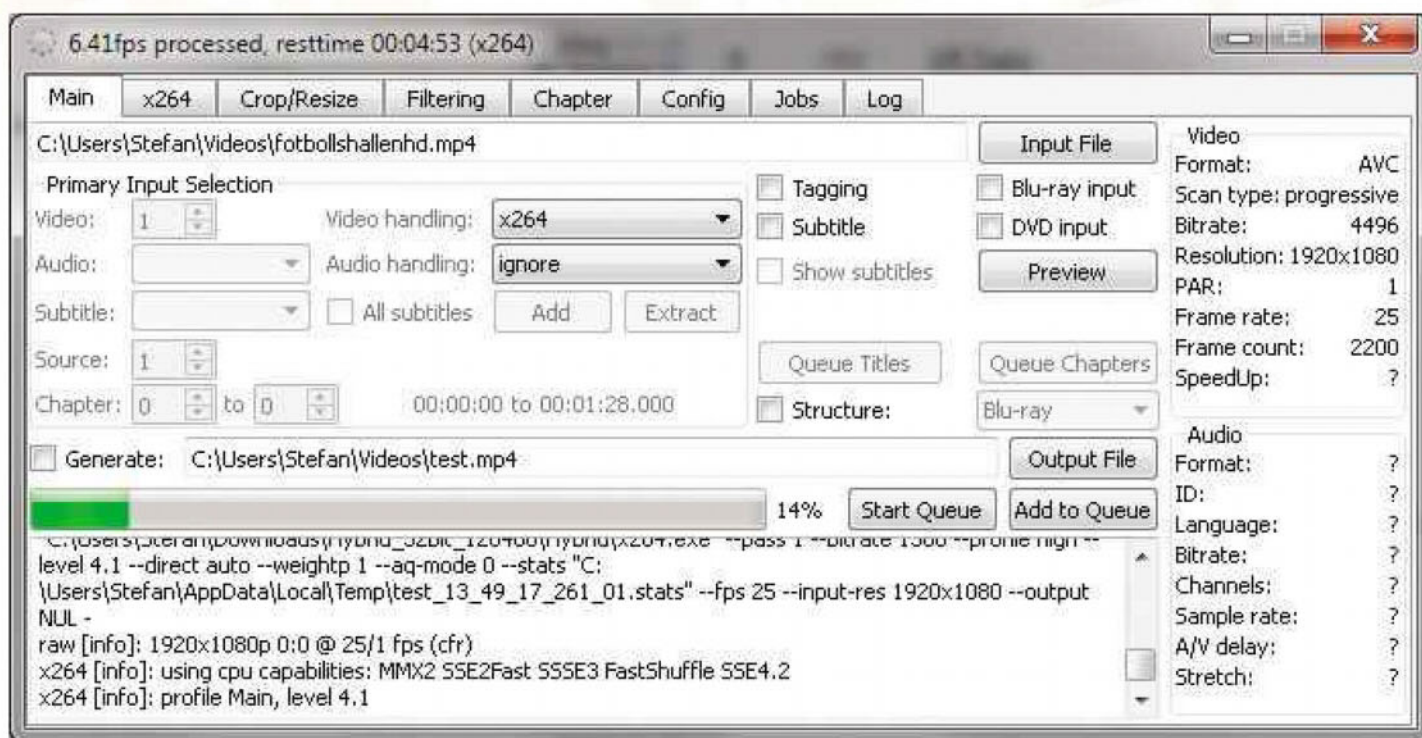
Wireshark is a network inspection tool that we thought was probably a little too powerful for its own good, being largely useful for high-level admins rather than home users. It still exists, however, and it's still being released – and that's great. It hasn't had a new stable release since July last year, but the in-development versions are apparently plugging along towards a version 2.0 release. It's still too much for home users, but at least it's there if you want it.

RealPlayer

uk.real.com

Reviewed Version: 16.02, Current Version: 17.0.15.10

Recently renamed RealPlayer Cloud, the software has undergone a complete revision into an online video player that, at the very least, gives it a few features you don't find elsewhere, such as Dropbox integration and native screencasting support. We're not sure it'll ever escape the stigma of its early years, but this version is, at least, a new direction for the brand.



encoders, who know exactly what things like sample rate, filtering and chapter queues are in relation to video editing software.

Its complexity does mean you can throw virtually anything at it, though. From MP4 to MKV, from Blu-ray to AVCHD, you can turn any type of video into any other type of video. It takes a while to get a handle on how it's set up and what everything means, but once you've nailed it down then you never have to learn it again. It's a universal converter, in that sense. It'd be nice if the progress through the application was a little clearer. We're not asking for a wizard, necessarily, but at least a logical progression would be nice. At present, the options are grouped by category so you'll find yourself jumping backwards and forwards through

the software while trying to set it up. There's a logic behind the design, but it's not the same logic that the user deploys when setting up a video conversion.

One good thing about Hybrid is that it's multi-platform, so you can use it across Linux, OS X and Windows machines. Despite this universal operation it's clearly not for everyone, but if you know what you're doing (or you're willing to jump on the learning curve in exchange for its flexibility) it's fast and powerful, and that's at least something you can respect.

Pros: Feature-packed and yet compact

Cons: Confusing and poorly organised

Rating: 4/5 mm

Remembering...

The Amstrad Mega PC

David Hayward like his PCs to be a little different

Back when 16-bit consoles were still king of the hill in terms of gaming, and the PC was only just starting to emerge as a gaming force to be reckoned with, there came along a bizarre marriage of both forms of entertainment. A kind of Jekyll and Hyde of systems, if you will.

The Amstrad Mega PC had all the look of a slimline PC. The familiar beige exterior, full-sized keyboard, mouse, and 14" monitor spoke of a smaller, new breed of personal computer. However, the Mega PC had a secret.

The front of the Mega PC had a sliding door section. One half, the right-hand side, housed a floppy drive, HDD LEDs and so on. But when you slid the door to the right, revealing the left-hand side of the front of the machine, a strange transformation took place.

The screen, which would normally display DOS or Windows 3.x, would now show a Sega Mega Drive. Indeed, as the sliding door hid the floppy drive, it unlocked a fully working Sega Mega Drive slot.

The Amstrad Mega PC was the second PC I ever owned, and considering it was only an Intel SX 25MHz machine with 1MB of SIMM memory, it was a considerable upgrade from the measly 286 I had been using for the year before.

To me, it was ace. A much more powerful PC with the added benefit of being able to play all those Mega Drive games I had collected, without having to dig the old Sega out and find the time to hook it up to the family TV. Plus the games were far better quality than on the TV too.

Did You Know...

- The Mega Drive portion of the PC came in the form of a PCI card. I wonder if you can get hold of one now?
- There was a white/beige Mega Drive controller that came as a part of the package.
- The PC still booted when you powered up in Mega Drive mode, so after a minute or two you'd hear the familiar Windows chime mid-Sonic.
- I didn't pay £999 for mine.

Its History

The Amstrad Mega PC, as licenced by Sega, was actually a European update to the Sega TeraDrive, which was released in 1991 and unfortunately never sold in the UK.

The Mega PC was launched in 1993 and took up a good double page spread in many of the magazines of the time – Micro Mart included, which is where I bought mine from. It wasn't cheap, though and hit the shelves at an eye-watering £999.99.

It was an absolutely ridiculous price to sell a 386 PC for, especially since you could get a 486 DX2-66 for half that price. Those who bought themselves one at near £1,000 must have kicked themselves black and blue, because Amstrad eventually dropped the price to a more reasonable, although still pricey, £599.

The Mega PC came with a 40MB hard drive, DOS 5.0 and the Amstrad Desktop, which was a kind of strange Windows/GEM GUI launcher for a number of programs that a seller could bundle onto the drive to make it a little more appealing to buyers.

In essence, it was a 'real' PC, but it did have some peculiar features. For one, the VGA port was a unique Amstrad design, which combined video and audio that would only work on an Amstrad-branded monitor – specifically the one sold with the Mega PC. While it worked well enough on a normal monitor, once you activated the Mega Drive side, the image and sound cut out.

The Good

A PC and a Mega Drive in a single unit. Sheer genius.

The Bad

Stupidly priced, limited power, not very upgradable.

Conclusion

The Amstrad Mega PC, despite its lack of performance, did give one user many happy hours in front of its 14" monitor. I can fondly recall spending hours playing *PGA Tour Golf* with my Mega PC.



▲ The Amstrad Mega PC, what a beauty!



▲ Genius idea, now if someone would combine a PC with that of an PS3...

RETRO ROUND-UP

Dave Edwards gets to grips with Spectrum gardening, tower defences and share dealing then eyes up two brand new Commodore releases

Welcome to another Retro Round-up, where we focus on all that's new in the world of the old. You may have noticed the focus of previous columns was entirely on 8-bit retro-gaming – heavily weighted to Spectrum, Commodore 64, BBC Micro and Amstrad games. Why, you may wonder, haven't we touched on the Atari, C16 or Colour Genie...? And why I haven't yet reviewed the handheld Sega Mega Drive I received for Christmas?

As an answer, I would direct you to the wonderful *Personal Computer News* website (www.personalcomputernews.co.uk), where you can read the entire run of this early Eighties magazine, should you feel so inclined. It really is a great trip into computing history for newcomers – or those with first-hand experience.

I write this column with the same editorial policy as that magazine had to apportioning column inches: thus, the machines that ruled the roost back get the most space here. A notable difference however is that *Micro Mart* no longer has to make do with black and white photographed screens. Instead, we can illustrate each review with both screenshots and a YouTube link. If you usually just skip these links then take the time to visit them. Each video lasts approximately one minute and has a full commentary (often similar, but not identical to the article itself). Moving images often convey in a few seconds what may take a reviewer a while to describe in text.

This issue we have the most intriguing selection of new releases for the Spectrum and Commodore 64 yet. Considering there was an incredible discovery for Commodore Plus/4 owners, it also gets a shout-out. We'll start out, though, by watering the plants...

It Never Rains But It Pours

Quantum Gardening is an ingenious game – combining elements of *Psst*, *Burger Time*, *Monsters* and *Ludo*. That may give you the impression that it's hard. It's not – but you shouldn't attempt it without reading its instructions. If you're watching someone else playing, it can appear positively bewildering.

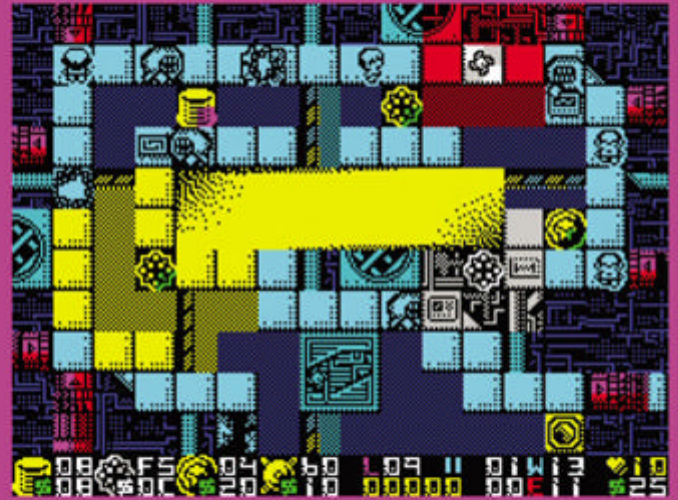
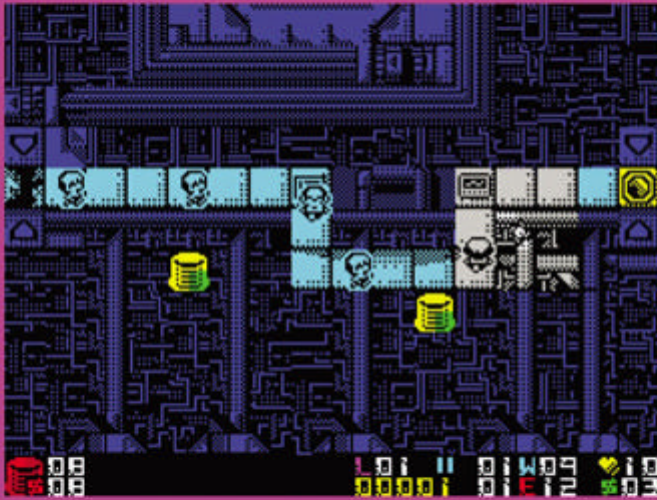
You're in charge of 'Eadwig', whose sole job is to make the plant at the bottom centre grow. To perform this task, he must provide it with rainwater; so that means the platforms above, between the plant and the sky, need to be shuffled around accordingly. That requires you to ascend and descend the ladders to each of them and remove any platform piece that may be causing an obstruction. Alas, the platforms are patrolled by a mutant Eadwig-seeking bean, and a bumble-bee that likes rearranging platforms as much as you do.

That's a game in itself but, in *Quantum Gardening*, that's only the half of it. Every few seconds, two dice tumble from the top of the screen and land somewhere – face up, displaying a number between one and six. If you're on one of the upper platforms these dice can be collected as soon as they appear; on other platforms you need to ease your way over to them. As soon as you do touch one

Quantum Gardening is an ingenious game – combining elements of *Psst*, *Burger Time*, *Monsters* and *Ludo*



Darn, and my quantum gardening was doing so well – until I rolled an infestation of snails upon my plant!



Captain Drex – the yellow blobs are the towers I've placed; along the cyan blocks none shall pass

of them, you trigger a move on a board game that surrounds the playing area. Any square that you advance to then causes an event, convenient or not, in the game itself. The raincloud squares are your ultimate prize as these start the all-important waterfalls to make your plant grow. Other squares – which differ by screen – award bonus points, swap the directional controls, kill the bean, infect your plant with snails or bring out the sun.

The skill of playing is never to collect a dice without first flicking your eye over to the board game and considering which square the cursor will advance to. As two dice fall simultaneously, the order in which you do (or don't) collect them is important. The two skills complement each other well; the ladders and levels are frenetic action, the collecting a strategic judgement call. The graphics are fair, and the sound rather limited, but neither noticeable in-play.

Quantum Gardening runs on the Spectrum 48K and can be purchased as an emulator image from Cronosoft. The game was produced on cassette and Simon Ulyatt of Cronosoft is considering another physical print run in the near future. So why not ask about reserving a copy if this goes ahead? See www.cronosoft.co.uk and watch www.youtube.com/watch?v=u3IBchPhruo

Hey Yo Captain Drex

Cronosoft's latest release is a Spectrum 128K tower defence game *Captain Drex*. You control a crosshair and each scene presents an overhead view of a winding path from the enemy start point to the enemy end point. After a short pause, enemies start to emerge, running along the path. If an enemy reaches the end of it you'll be saying goodbye to one of your ten lives so, to prevent this, you'll want to invest in constructing towers by the side of the path. Towers that pound any enemy to smithereens before he can get anywhere near his goal.

A sublime version of this type of game was *Fieldrunners* for the iPod Touch, and *Captain Drex* owes a lot to this game (I'd be surprised if author Vladimir Burenko had not played it). In both, there are enemies who can withstand lesser or greater amounts of damage and four distinct types of tower – and when I said earlier that you would be "investing" in these towers, I meant it quite literally. You start *Captain Drex* with \$20 and each tower costs \$8. For every enemy you kill, you gain a \$1 reward.

Hence the skill is the perfect positioning, and constant upgrading, of towers to continue decimating enemies, even as they begin to increase in strength.

There are a number of screens (i.e. level layouts) to play, although the game starts out with such a challenging difficulty level that there will be a fair few gamers stuck on scene one for at least a week. It's a good try at capturing the feel of *Fieldrunners* on the Speccy – you can even use the pause key strategically like in the original – but there are some obvious disadvantages. Firstly, the crosshair is difficult to control and, in a game where seconds count, every mistake it makes results in what feels like unfair life deductions. Secondly, although it does some clever things with the Spectrum's colour set, it doesn't escape from that effect of looking like a monochrome game being viewed through a red or blue filter. This makes it hard to see what's going on and, quite importantly, whether your towers are actually firing!

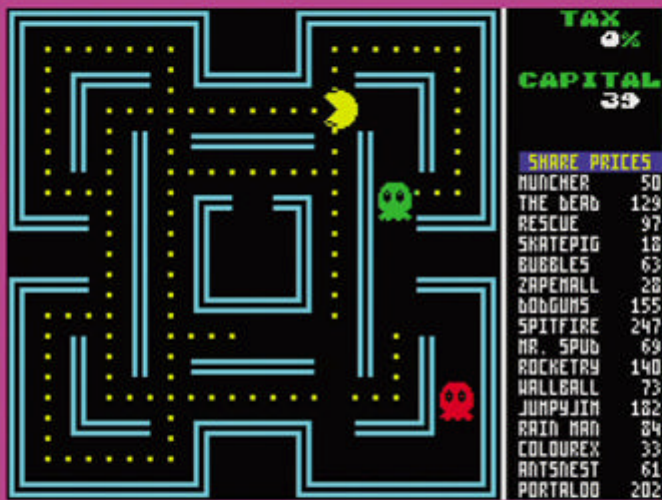
Those are really the only criticisms and the game is a lot more engaging than some of Cronosoft's other titles. It's difficult to pin down why. A bit like *Tetris*, it's one of those games that, when you die, you just want to play again. I've wrestled with it now for a good five hours or so and my advice is that it's definitely better to upgrade towers rather than build more of them.

You can see the game in action at www.youtube.com/watch?v=R01ga9BMLIY and buy your own copy of it for £4 plus P&P.

The Game X Factor

Our final Spectrum Cronosoft game this issue is *Gamex: The Game Exchange*, which almost amounts to a compilation rather than a single game. It includes sixteen 'mini' games within it, across a variety of themes: platformers, pac-man style chasers and space invader type shooters being among the more familiar.

A bit like Tetris, it's a game that, when you die, you just want to play again



Muncher is the first game you'll play of Gamex; Rescue costs more and share prices fluctuate

So far, so blah blah. However, *Gamex* is from the mind of Jonathan Caldwell, so you can probably guess there's to it, and there is: stock market trading, to be specific. Instead of a menu, each game must be 'bought into' before you can play it. You start with enough cash to buy *Muncher* (*Pac-man*) and *The Dead* (*Zombies*) and, once you've acquired them, you gain more cash by playing them well. Each game you have shares in also generates a dividend each 'turn' and forces you to play it yet again to continue. Once you're bored of it, dump your shares in it and invest your cash in different games. Rinse and repeat.

Gamex is tape-based and designed for the Spectrum 48K. It's not multi-load which means, for sixteen games, each one has, on average, just 3K in which to run. You would never believe it! *Muncher*, for example, is full-screen, challenging and the sprites flow smoothly around the screen. In fact, some of the games included are so good that, had the themes not already been done to death, they would be revered as extremely competent versions in their own right.

The share-dealing idea, however unique a selling point, won't be everyone's cup of tea, though. The main problem with it is that you aspire, from start-up, to play those games that you can't afford. However, being forced to play umpteen games of *Muncher* to get them has quite a damaging effect on that aspiration. Even though the games are good versions, none of them are built for continued play; you don't tend to play games like *The Dead ad infinitum* – so when its dividend pops up you groan, rather than excitedly dive in again.

Gamex is still a superb game and, considering the Spectrum's limitations, what has been squeezed into a single block of code is almost miraculous. It's all available from Cronosoft at £4 plus P&P.

Bucking Hell

Buckaroo Banzai isn't a new retro game *per se*, nor is the new Commodore Plus/4 version of it a new release by some homebrew developers. However, the story of how it has been recently discovered is certainly interesting enough for me to give it a mention this issue.

Originally one of the last text adventure games from Adventure International, *Buckaroo Banzai* was written by Scott Adams and released for a multitude of formats in the mid-eighties. Amongst these was the Commodore 64, which received a graphical version on 5.25" disc. Unfortunately, the game is an extremely tedious quest

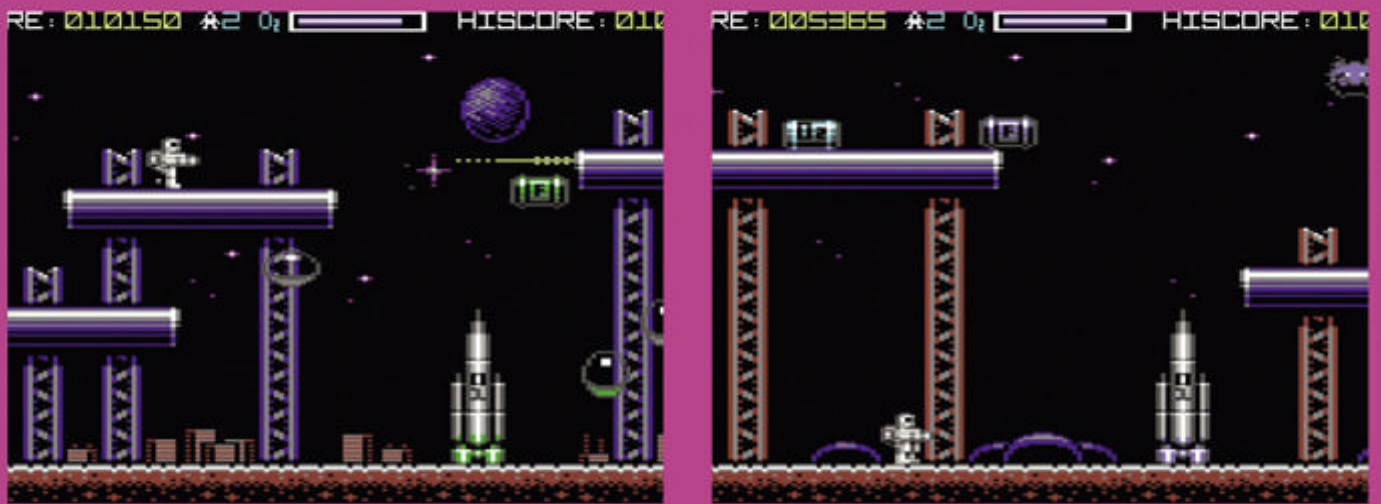
to fix a jetcar with a flat battery. With or without graphics it's pretty uninspiring. Many versions on many formats were so bugged that their releases were considered a scandal back in the day. However, the C64 version did work well and so remained pretty much the only option for those fans of the cult movie to puzzle over.



Buckaroo Banzai, I want you to wash hose



The graphics give Buckaroo Banzai some ambience – which the long "Please Wait"s prompt decimate



Existing superlatives don't do justice to *Rocket Smash Ex*!

Until, that is, a few months ago, when someone stuck an upside-down Commodore 64 disc into a Commodore Plus/4 drive and, to his amazement, found himself playing a complete version for the Commodore Plus/4. As there is no clue to its existence on the packaging, the disc or the inlay, it had remained undiscovered for over 30 years.

This version of *Buckaroo Banzai* features some nice chaining puzzles, as Scott Adams was somewhat famous for. One of these involves you having to clamber up a wire to reach a crystal buried in a rocky mountain. You have a pickaxe, but need both your hands to climb, meaning you can't chop the crystal out when you ascend to its location. The solution? Tie the end of the wire to the pickaxe, climb it and then haul the wire up to the new location, bringing the pickaxe with it. Clever stuff.

The graphics are also imaginative and really bring the adventure to life, particularly those of the stricken jetcar, which are particularly good. There's even a few rudimentary animation sequences when you perform actions like digging.

Alas, that's not a recommendation to go play it – although it's clearly better than a version where you clamber into Buckaroo's jetcar only to get trapped inside it! The big problem is loading times. They are so long – despite this being disc-based! – as to ruin *Buckaroo Banzai* entirely. Even a simple TAKE PICKAXE results in the screen displaying 'Please Wait' for half a minute before writing 'You have the pickaxe'. Fancy just going through it with a walkthrough? Set aside half a day.

Personally, I'd bet Adams and his team realised this Plus/4 version was the game equivalent of *Lost In Translation* as soon as they attempted to play through it. So perhaps this explains why it never saw the light of day until now.

Rocket Smash Ex – Retro Find Of The Month

Since I began this column I've reviewed three games for the Commodore 64 by Psytronik Software. All three of them have been completely new ideas with gorgeous graphics and whole teams involved in their development. *Rocket Smash Ex* is the first Psytronik game however that has me totally blown away.

The game is fantastically simple. You control a spaceman, and your objective on each screen is to manoeuvre through platforms collecting the items that fall from the top of the screen. In succession, two pieces of rocket will fall, then three fuel pods; each item obligingly waiting to drop until you have dealt with

the previous one. You know exactly where each item needs to be dropped because the very first piece of your rocket is positioned there at game start. So all you need to do to complete a screen is grab each item that falls and take it to that very place. Last fuel pod will operate the rocket thrusters and you can board it and escape to a more difficult screen.

If you're thinking that all sounds just like Jet Pac, that's because it is – *Rocket Smash Ex* is a souped-up version of the old favourite. You won't be at all surprised to find that managing to improve this classic has given Psytronik an instant winner. Yes, from the thunderous sampled 'Get Ready', through the amazing music, graphics and sound effects to the booming 'Game Over' terminator, *Rocket Smash Ex* is a smash in all senses.

Each screen has a different spectrum of aliens, who attack with a different strategy. Every four screens you get a swift cutscene which increases ambiance without being intrusive. The game controls are exceptional, allowing you to gracefully glide or carefully tread from A to B as current conditions require. Collide with an alien and you audibly groan but the game merely freezes, makes its point and then continues. This is a great approach; some other versions force you to start from rocket piece one again. Not so here.

There's a high score table, an extensive options menu and a choice of sound. I've personally experienced some of the laziest ports of Jet Pac imaginable on other machines and this is the best version I have played ever. For a sample, see www.youtube.com/watch?v=gmujcAYtiq0.

It's available now – although selling fast, for obvious reasons – from Psytronik for £5 plus P&P.

Calling All Homebrew Developers

In rounding off this article, and assuming that those authors of the games featured do read my thoughts on them, Retro Round-up is your chance to have any game you are writing immortalised in the pages of *Micro Mart*. All you need to do is drop a quick e-mail to editorial@micromart.co.uk attaching an emulator-friendly version of the game along with any information you feel to be pertinent (this would certainly include its price, if it's not free). Make sure you mention its release date and – as if it needed saying – make sure it's in a retro style.

Contributions or not – and assuming I can tear myself away from *Rocket Smash Ex* – I'll be back next month. **mm**



The Best Of Google Chrome Web Store

Google's Chrome web browser is perhaps the most powerful piece of software on your PC, as **Keir Thomas** explains

To talk of Google Chrome as a mere web browser is so 20th century! The software used by around half of all PC users is better described as a web platform, and some would even call it an operating system. Using it to view your favourite sites is like doing the school run in James Bond's Aston Martin – it'll do the job but it's capable of much more.

In the eyes of Google, a key function of Google Chrome is to run apps. These are available in the Chrome Web Store (chrome.google.com/webstore), which is similar to most other app stores such as those for iOS or Google's own Play for Android. And this brings us to a second naïve assumption, which is to think the Google Chrome apps are merely repackaged web technologies, which implies they're inherently limited. While Chrome apps are built using the same machinery that drives the web – such as HTML, CSS and JavaScript – nowadays they have access to underlying components of the full operating system via special programmer interfaces built into Chrome. Apps can communicate directly with USB or Bluetooth devices, for example, making it possible to create hardware device drivers as Chrome apps.

Nor do Chrome apps have to fit within a browser window, as in days of old. Most look and function like native apps in their own windows, and they install direct to the hard disk too, so they can work even when you have no internet connection. Indeed, many Chrome apps are specifically designed to do so.

The final mistake many make is to

assume the entire range of apps in the Chrome Web Store is off limits to those who don't own a Chromebook. If you have the latest Chrome browser installed on Windows, Mac or Linux, then you can do every single thing a Chromebook owner can. A Chromebook is simply a laptop built around a basic operating system that itself is built around the Chrome browser.

Below are eight picks from the Web Store. All can be installed by simply visiting the Chrome Web Store, searching for them and selecting to install, and are free of charge. On installing the first app, a new Chrome App Launcher icon will be added to the taskbar, which works like the Start menu to offer access to apps. You'll also find a Chrome Apps folder added to the real Start menu. Each app has its own taskbar entry when running, just like any native app, and can even be pinned to the taskbar. The Chrome browser doesn't have to be open for the apps to work.

VNC Viewer For Google Chrome

VNC is screen-sharing technology similar to Microsoft's Remote Desktop, although it's open source and supports just about every major computer platform in both server and client versions.

VNC Viewer for Google Chrome is a client that lets you tune into other desktops, and it has two main advantages: it's produced by RealVNC (www.realvnc.com), one of the biggest commercial names producing VNC

software, and it's entirely free of charge. In situations like this the cynical among us tend to expect the apps to be cut down or borderline useless but, nope, VNC Viewer for Google Chrome scratches just about every itch you might have now and in the future.

Once you connect, typically by typing the IP address of the remote machine, the remote desktop appears in its own app window. A toolbar at the bottom lets you switch to full-screen mode, removing the window controls, and if the client and server screen resolutions match, then you have 1:1 representation, making it just like sitting in front of the remote machine. If the remote machine has a higher resolution, you can click the scale button – something that had no noticeable effect on performance in our testing and didn't look ugly either.

The toolbar at the bottom of the screen allows access to these features, and this can be unpinned so that it slides out of view when not needed.

In short, VNC Viewer is an excellent example of a Chrome app and destroys in the blink of an eye the myth that Chrome apps are inherently simple or limited in what they can do.

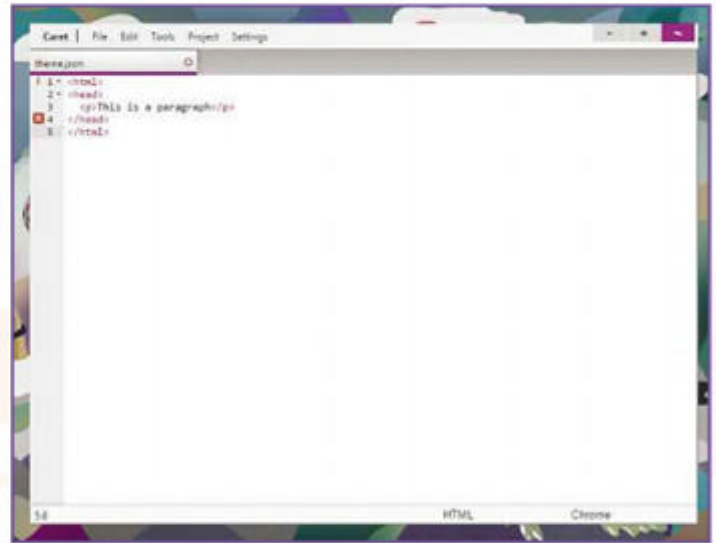
Caret

If Chrome is to be considered a type of operating system in itself, and some would argue that is indeed the case, then it surely needs a basic but comprehensive text editor.

Caret fills these particular shoes. It's not the prettiest app around (although



▲ VNC Viewer for Google Chrome lets you tune into any desktop that's running the free VNC server software



▲ Caret is a comprehensive text editor for programmers that has a stunning array of useful and sophisticated features

if you know enough JavaScript/CSS you can customise the app interface via a menu option), but it excels with genuinely useful features. These include tabbed editing so you can work on multiple files at once and not only syntax highlighting but also parsing. In other words, Caret will colour your code to make it easier to read at a glance and also inform you when you make a typo via an X in the left margin (which contain line numbers, by the way). Syntaxes understood and that are selectable from a menu at the bottom of the screen include practically every language you're likely to encounter – from HTML to C++, and it even includes curiosities such as X86 Assembly and Erlang. Caret also includes automatic tag completion, so if you type a `<p>` when coding HTML, it will automatically add `</p>` to the right of the cursor.

Comprehensive text formatting and search tools are the icing on the cake, as is a macro recording tool that can record keystrokes for quick playback. There are even project management tools built in so you can manage all your files in one place.

Considering all of this is contained within a Chrome app and it's also free, there really isn't anything to complain about – but much to be amazed by.

Polarr

Online photo tweakers are not rare, but Polarr combines the one-click ease of use of ready-made filters with some very sophisticated tools that let you create your own looks and that you might not

“ Apps can communicate directly with USB or Bluetooth devices, making it possible to create hardware device drivers as Chrome apps ”

expect to find in what is intended to be a consumer-level app.

The basic stuff lives at the left of the screen, where you'll find the various ready-made filters – referred to in Polarr-speak as Looks. If you've used pretty much any Instagram-a-like editor recently, then you'll know what to expect. The currently open image is shown as a live thumbnail preview under each, and clicking any instantly applies it. Beneath the Looks is a History heading, by which you can step back through each individual action right back to when the image was opened.

At the right of the screen are the main controls, which are what are adjusted to create each Look, including creating any number of custom Looks. At the top right is a histogram display, and beneath this are sliders to adjust what Polarr calls Basic settings – exposure, gamma, vibrancy and so on. Beneath this is a Tone Curve, similar to that found in Photoshop, which you can drag to experiment with colour saturation and brightness/contrast. Further down are HSL controls (hue, saturation, luminance), split toning controls that let you adjust highlights and shadows, details sliders that let you

adjust sharpness and remove noise, lens correction sliders that let you negate distortion caused by wide lenses and also remove colour fringing, and finally an effects heading that lets you add faux grain and vignette effects.

Curiously for an app built using web technologies, Polarr loads and saves to and from your hard disk and doesn't include cloud integration such as Dropbox or Google Drive support. You can, of course, choose to save to your own choice of cloud storage from the File Save dialogue box, but a one-click option would be nice.

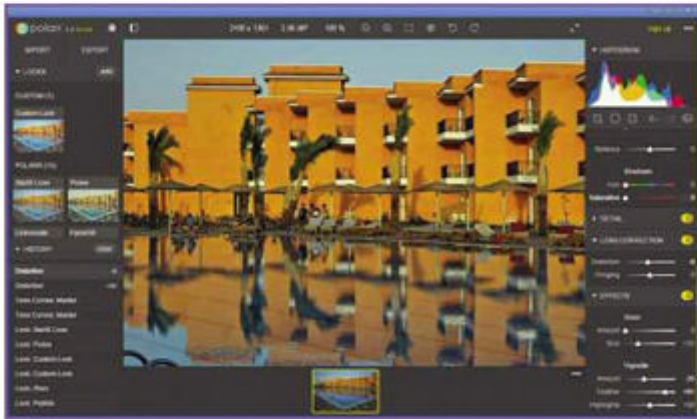
Polarr is powerful yet straightforward and really does bridge the gap between basic and advanced-level image tweaking.

WebFlowy

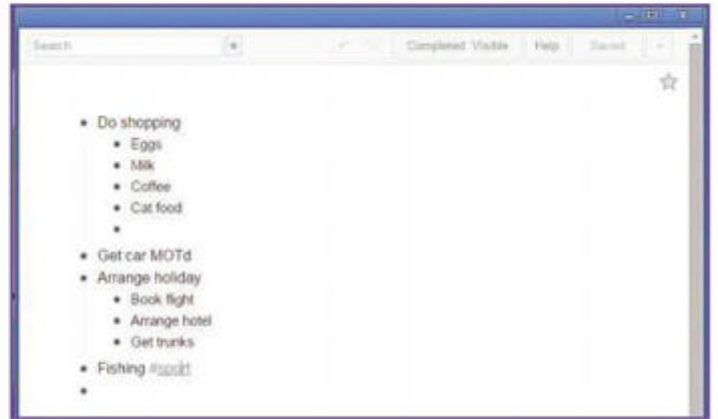
Keeping up with your task list is a booming app industry and WebFlowy is one example that offers true cross-platform support. You'll find it on Apple iOS and Android devices and online via a website. This app brings it to Google Chrome.

You'll need to create an account when starting the app, but this enables the cloud syncing function that lets you (or

▼ If you want the ability to add one-click filters and also the ability to create your own image tweaks, then Polarr is for you



▼ WebFlowy allows you to create To Do lists across multiple devices, including via Google Chrome



others) simultaneously edit your lists across multiple devices. In other words, add a new entry to list in Google Chrome and it'll appear within seconds on your Android phone too. WebFlowy's own servers are used for this, rather than DropBox or Google Drive.

The goal of the app is to be simple yet sophisticated, and the app opens to a blank document, in which you can start typing your list immediately. Each entry can be turned into a heading for nested entries beneath, and this is done by clicking the bullet point at the left of the list item. In fact, WebFlowy will let you create an infinite number of nested items – your shopping list could include a vegetable section, for example, and within that section you could include a separate section for the different types of mushrooms you want to buy.

By hovering the mouse over the bullet point, you can also mark entries as being completed, in which case they're scored through as if crossed out. Text notes can be

added to each bullet point too, and you can also share, duplicated or export them – all tools that are very useful for collaborative working. Lists can be tagged in a Twitter-like way using a hash before a word.

The drive for out-and-out simplicity in WebFlowy left us scratching our head a few times, and we still don't quite understand how to create new documents, but there's little doubting the utility and power on offer.

Solitaire

Of course, the true definition of an operating system is whether it comes with Solitaire, and this app brings the full range of games you might expect: FreeCell, Klondike (including Klondike by Threes), Spider (four, one and two suits), plus less typical variations such as Pyramid Easy, Golf Easy and Forty Thieves.

Gameplay is happily typical and unexciting – cards can be dragged around and placed on other cards or in the holding spots until the game is won

or no more moves are possible. The less confident player will be happy to find an Undo button, as well as a Hint tool that highlights possible next moves.

Clicking the appearance button lets you chose between various card-face designs, and you can also change the table design away from green felt. We particularly liked the blue felt, but wood-based designs are also available.

We'd love to tell you what happens if you win – and whether the Windows-like bouncing card effect is witnessed – but a complete lack of skill as well as limited reviewing time didn't allow this. Still, as far as we could tell, this is a faithful and enjoyable recreation of the office workers' favourite, so it's well worth a look.

VBA-M

Included in this group test if only to show the technical tour de force possible with Chrome apps, VBA-M is an emulator for the Game Boy Advance handheld console. You just supply it with a ROM file (as a

▼ Practically all the favourite solitaire games are available under Google Chrome – ideal for playing while pretending to be working



▼ VBA-M is a Game Boy Advance emulator that runs on every platform on which you'll find Chrome, whether that's x86/64 or ARM



“ In the eyes of Google, a key function of Google Chrome is to run apps ”

zip) and start playing. It works on just about any platform, whether that's a PC running Chrome or a Chromebook powered by an ARM processor.

If you have a gamepad attached, you can use it as a controller – even Xbox 360 controllers will work – and you can import saved game states from other emulators. Z, X, A and S act as the A, B and L, R keys respectively, and the cursor keys as the D-pad. Emulation can be speeded up by tapping the Space key, although in our tests this wasn't necessary and everything ran pretty smoothly even when the window was resized. The app is based on the open source VBA-M project, which is widely respected within the emulation community.

Assuming you're signed in with the Chrome browser, any saved games or screen captures you create (Shift+F1-F9 or F12, respectively) will be saved to Google Drive, enabling you to sync across multiple computers or devices.

There isn't a great deal more we can say about this app. It works and is loads of fun, and it's simply mind-blowing when you consider the technical difficulties inherent in making it work across all computing platforms on which Chrome is found.

Sticky Notes

One of the most basic apps for an operating system is one that allows note taking. Microsoft Windows is a peculiar exception to the rule that most operating systems include some kind of Post-It Notes-

emulation – Linux and Mac OS X do so, for example.

Sticky Notes for Chrome comes to the rescue and syncs to Google Drive, meaning you can run it anywhere you use Chrome (or a Chromebook) and have instant access to your data. The app is sandboxed, which means it can only access its own data and nothing else within Drive, and syncing is indicated on each note by an animated icon.

Notes can have their colours and fonts changed, and clicking the M icon reveals a menu that, among other things, lets you make a note sit permanently on top of other windows, as well as share the contents via Facebook or online via a QR code that you can then pass to others that contains the URL (which is listed beneath in case you simply want to copy and paste it into an email).

In addition to switching fonts, you can also add bullet and number points, and the usual Ctrl+B and Ctrl+I shortcuts work fine for adding bold and italics respectively.

The Options dialogue box for the app offers a handful of fixative actions that clear Sticky Notes' cache and storage, which might be useful if things go wrong.

In our opinion, this app manages to walk the fine line between simplicity and functionality. There's powerful functionality there if you want it, but for quickly jotting down info it can't be beaten.

Gliffy Diagrams

Online office suites can be described diplomatically as embryonic. Google Docs

offers some unique features, such as superb collaboration tools, but those used to Microsoft Office are in for a culture shock should they make the switch. As far as usability or functions are concerned, Docs is simply several generations behind Office.

Third-party apps aim to strengthen Docs' market position, however, and Gliffy Diagrams is one. Essentially, this is a Visio clone designed to let you create all kinds of diagrams – from flow charts to network topologies.

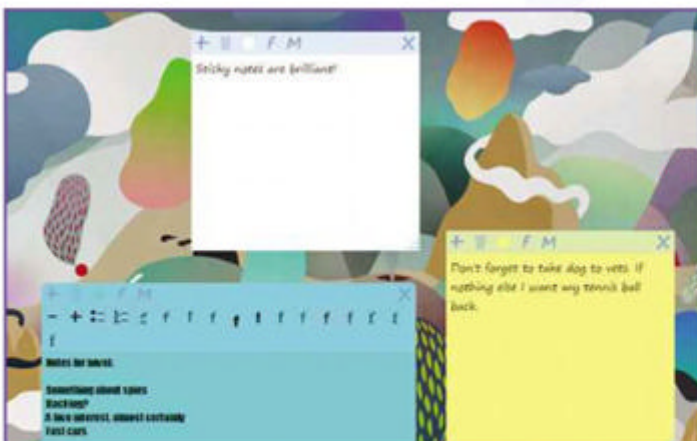
The left of the program window shows a list of headings, underneath which are ready-made shapes that you can simply drag to the page. Pretty much every flowchart icon is available, for example, as well as the likes of Venn diagrams, attractively designed network icons, floorplan planning structures and more.

A toolbar running across the top of the screen contains primitive shapes, such as ellipses, rectangles and a text tool, as well as lines and also connectors that you can use to join together flowchart entries. Just about everything you draw is customisable to some degree, and tapping each shows a floating toolbar that lets you modify it.

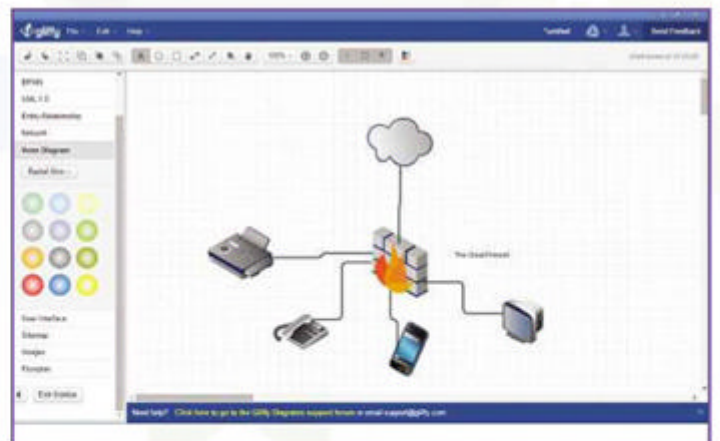
Your creations can be saved locally as .gliffy files for further editing or outputted as JPG or PNG. You can also tie into your Google Drive account, of course, although this requires you to pay upwards of \$3.99 per month to subscribe. Gliffy is otherwise free of charge.

Gliffy is an excellent example of the sophistication available in Chrome apps. This isn't a cut-down or limited version of what you're used to; it's a genuinely useful tool that rivals anything that might be installed on your system via a CD or a download. [mm](#)

▼ With cloud syncing across multiple devices, Sticky Notes makes jotting down information easy regardless of wherever you are



▼ Gliffy Diagrams lets you quickly create just about any kind of diagram, from flow charts to network topologies





David Hayward has been using Linux since Red Hat 2.0 in schools, businesses and at home, which either makes him very knowledgeable or a glutton for extreme punishment

Free Linux Books

What's available, and where can you get them?

I was looking for a specific book on Linux commands the other day, as a kind of relearning and getting back to the CLI exercise, after I realised I had been spending far too much time using the GUI way of navigating and controlling Linux.

After some Googling, I was quite surprised as to how many free ebooks are available for Linux. Naturally, there are loads for other systems, programs and whatnots, but since it was Linux I was searching for, they were the ones that cropped up.

Anyway, I thought I'd share a few of the fine examples I found with you.

Linux Succinctly

Jason Cannon

goo.gl/283qZL

Linux Succinctly is an interesting book that helps you get to grips with the basics of Linux, specifically the command line, directory structure and so on. You'll need to sign up for a free account before you can

download it, but that's not a big deal.

Bash Guide For Beginners

Machtelt Garrels

goo.gl/wNtFby

Linuxtopia has an enormous collection of online books and tutorials for anyone to browse through. This one focuses on Bash scripting, common shell programs, script debugging and much more. It's quite an achievement and one that's very easy to read too.

Getting Started Guide To Linux

Stefan Neagu

goo.gl/5sXRQN

Make Use Of often has some decent guides on its site, one of which is this handy getting started guide. It's looking a little old these days and tends to deal in distros that have since been updated many times over, but the core essentials are there on how to get a distro, burn it to disc or write to USB and how to install

it. If you're a beginner, this is quite a useful resource.

Rute User's Tutorial And Exposition

Paul Sheer

goo.gl/pu2GhX

Rute User's Tutorial and Exposition is an excellent book that goes into great depths covering Linux system administration for Red Hat and Debian systems. Both new users and more advanced administrators can get quite a lot from this book, and those studying for Linux-related exams would also find this a useful and handy reference.

Advanced Linux Programming

CodeSourcery LLC

goo.gl/Bklj0T

As the title suggests, this is a more advanced look at developing within Linux. If you already know C and can find your way around Linux, then I imagine this would be a great reference. If you're just starting out, there's plenty in here to keep you busy for weeks.

Needless to say, these are just the tip of the iceberg; there are hundreds more out there waiting to be read and absorbed by hungry minds.

All of this makes me wonder what else is out there and what reading material to recommend to someone who's starting out in Linux or who is after something a little more specific. True enough, it's easy to simply Google a question, but more often than not you'll get an overinflated answer or something completely wrong. That's where a good book comes into its own and can help guide you to the path of enlightenment.



Sherlocking Apple

Fantastical 2 isn't especially fantastical, but it is pretty fantastic, says Craig Grannell

During Apple's history, plenty of apps have been 'Sherlocked'. This refers to Apple unveiling the Sherlock web search tool way back in Mac OS 8.5, more or less duplicating third-party app Watson's functionality. The lesson was clear: sometimes Apple would look around for something great, take ideas for itself and leave the rival product in the dust. After all, if Apple's offering something built-in and entirely for free, why would you pay for a fairly similar product?

The release of Fantastical 2 blows that kind of thinking out of the water and then grinds any particularly stubborn thought fragments into the ground, for good measure. It's a commercial product that ostensibly does little more than mirror the functionality of Apple's Calendar and, to some extent, Reminders apps. In theory, it should be completely superfluous to requirements and the kind of commercial suicide that's rare among savvy software developers. In reality, it comes across as a slice of genius.

The main thing Fantastical 2 gets right is simply that it's really good. That might sound like an obvious barrier to leap over for a piece of software, but few OS X users would claim Apple's own Calendar and Reminders apps are anything more than workmanlike. They certainly don't think differently in any manner that makes things more efficient when it comes to managing your time. By contrast, Fantastical 2 bundles features that are so obvious, it's crazy Apple didn't include them in its own products.

First and foremost, Fantastical provides an endlessly scrolling sidebar that lists your upcoming

events. Apple's app, though, restricts you purely to a day view, ignoring whatever's going on tomorrow. The upshot is Fantastical is a much better product for planning ahead and quickly gaining an overview of what's coming up. It feels more like a dynamic interface designed for modern computing, compared to Apple's, which remains too heavily rooted in the past, aping the structure of print-based calendars and organisers.

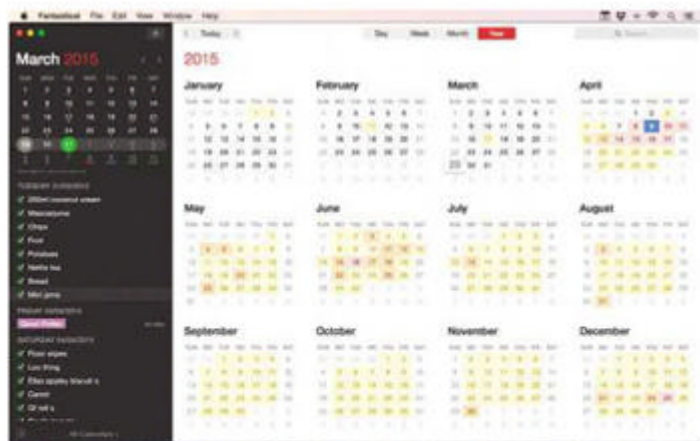
The other thing Fantastical does really well is using a kind of natural language when making appointments. Type in 'Lunch next Friday at 1pm to 3pm', and Fantastical will correctly interpret what you input, helpfully building the event's details as you go. You can therefore make adjustments and know when you click 'Add Event' it'll be in the right place. Apple's Calendar dumbly ignores the 'next' bit of that sentence and plonks the same event on the current Friday.

Fantastical is an app that, once used, makes it very difficult to conceive of returning to Apple's own equivalent products. There are a few issues, the only notable one being that Fantastical polls

iCloud only fairly infrequently for data, a five-minute minimum not comparing to Apple's immediate 'push' refresh. Even so, it's like a kind of reverse-Sherlock, seeing a product that has the quality and data integration to shove Apple's default apps out of the way for good. Of course, that's not to say Apple doesn't have a beady eye on Fantastical, and none of its ideas would be overly difficult to steal. Perhaps in the future, we'll see a reverse-reverse-Sherlock, with everything that's good about Fantastical ending up welded to OS X itself. In the meantime, we should be grateful developers are still willing to take on Apple, even if doing so initially seems like they're the crazy ones.

A free 14-day trial of Fantastical 2 for OS X is available from flexibits.com/fantastical. The app can be purchased on the Flexibits Store or Mac App Store for £29.99. The app is also available for iPhone and iPad, costing, £2.99 and £5.99 respectively.

▼ *Fantastical 2 betters Apple's Calendar in almost every conceivable manner*



Craig Grannell is a writer, designer, occasional musician and permanent loudmouth. He's owned Macs since 1996, when Apple was facing certain doom, and is therefore pleasantly surprised by its current success. Find Craig on Twitter at @craiggrannell

Mac



Ian is a professional IT analyst, a semi-professional writer and a pretty amateur electronic musician. He likes gadgetry and loves making gadgets do things they were never designed to do

Virtual Droids

Ian McGurran looks at how to run Android apps on your computer

Virtualisation, the running of an operating system within another operating system, isn't a new idea by a long long way. In fact, for some operating systems it represented the only way of using one in a different environment. Windows, for example, was only able to exist on a non-x86 platform such as Mac OS by virtue of being hosted in a virtual machine. Virtualisation has come a long way since then, though, far from the curios of back then to business as usual for many, and virtual machine use in enterprise is common practice for loading separate 'servers' on to one single server.

It's not just for desktop operating systems, though, and recently Google itself added to the pile of methods with which the Android OS can be virtualised, with a Chrome extension called Arc Welder. How does it stack up to the competition?

BlueStacks (bluestacks.com)

Previously the leading Android emulator, BlueStacks is still a very capable emulator that is especially geared towards a simple, gaming-centric experience. Running on an older version of Android Jelly

Bean, it's still pretty compatible, but BlueStacks promotes recommended apps that it claims work well on the platform. It's mostly games, but if you want a solid gaming experience that's easy to use, then maybe BlueStacks is for you. If you're after productivity and more... there may be a better alternative...

AndY (andyroid.net)

'AndY the Android Emulator' is the new kid on the block that many see as the usurper to BlueStacks' crown, and it's with good reason. Android 4.4 and a more rounded Android experience are the headlines here, so where BlueStacks is a one (impressive) trick pony, AndY may well appeal to those whose use of Android may extend beyond games. Home apps, WhatsApp and even rooting can all be done on AndY, and because it's running in an Oracle Virtual Box, AndY is even further tweakable for getting extra performance out on more powerful systems. Plus you can make copies if you want to experiment without losing anything. Some have noted, however, that the makers of AndY have connections with an adware company, though it's claimed there's no untoward software in AndY at all.

AMIDuOS (amiduos.com)

Better known for its motherboard BIOS code, DuOS is American Megatrends' Android OS environment for PCs. Running as a separate application, the user is supplied with a virtual device running Android 4.0 Ice Cream Sandwich in an x86 environment. In use it's much the same as running Android elsewhere, though the age of the OS isn't ideal, and later revisions worked better on x86. However, it's easy to use, it's free, and there are simple instructions for installing Google Play services too.

Arc Welder (Chrome extension store)

And so to the newbie, Arc Welder. Unlike the previous examples, Arc Welder doesn't work as a virtual machine, requiring a full installation of the Android OS. It installs a large 43MB extension to the Chrome browser itself, from which you run the APK files themselves by adding them to Arc Welder. Yes, Arc Welder is a development application so no, it won't have Google Play to download from and yes, you'll need to go find the individual APKs for any apps you want to use. Not all work either, hit and miss being the order of the day. As a testbed for your own Android apps, it's fine, but don't expect a virtual Android environment.

So sadly Arc Welder isn't a simple way to run Android on your Windows tablet. What's more, the alternatives may be fine on desktops, but they also struggle on the lower specs of the current Atom-based devices, especially those with only the 1GB of memory. But it's a good start, and the next generation of Windows tablets, with more memory and faster processors, may offer Android a suitable virtual home, giving Windows 10 a very interesting card up its sleeve.



iCaved In And Bought One

Andrew Unsworth barks about his new dog and bone

After many months of careful thought, detailed consideration and much tightfistedness, I've finally succumbed to necessity and bought a shiny new iPhone 6. The new phone is to replace my faithful, old iPhone 4S, which has served me well but struggles to give me a full working day of battery power and is increasingly docile after years of software updates.

I mention this not as some print-based humblebrag (honestly), but because the consumer journalist in me wants to stand atop Mount Chuffed and preach words of wisdom to those looking to get an iPhone 6 or, failing that, anyone who'll listen. Listen they should too, because the iPhone 6 is a fast, capable phone and for me it's the phone to buy if you're either locked into or are happy with the Apple ecosystem. As much as I like the iPhone 6 Plus, with its large, full HD screen that is super-easy on these longsighted eyes, it's just too big for me to use one-handed. For anyone without hands like coal shovels, the iPhone 6 is definitely the one to buy.

Beauty is in the eye of the beholder, and this beholder's eye tells him the iPhone 6 is hotter than a chili-coated Charli XCX strapped to a flame-grilled sunbed. However, that doesn't stop the iPhone 6 seeming a bit dated compared to certain rivals such as the Android-based HTC One with its dual speaker system and the LG G-series phones with their fancy gesture controls. Even so, I like the iPhone 6's elegant design.

As for performance, the iPhone 6 absolutely flies. Mine

completed the SunSpider JavaScript benchmark (tinyurl.com/4h87sa2) in just 340.6ms, while my old iPhone 4S completed the same test in a leisurely 1,819.6ms. Of course, a brand-new iPhone 6 is bound to be faster than a battered old 4S, but to put the score in context, my Intel Atom D7200-based word-processing PC completed the test in 1,327ms. If you do a lot of web browsing on your phone, this result shows that the iPhone 6 is more than fast enough to handle it.

As for graphics processing, the iPhone 6 scored maximum points in 3DMark's Ice Storm and Ice Storm Extreme, and

17,277 in the Ice Storm Unlimited test. This shows the iPhone 6 can handle any game in the App Store with aplomb. Meanwhile, my old 4S failed to complete the Ice Storm Extreme benchmark and scored 2,388 and 2,169 in the Ice Storm and Ice Storm Unlimited tests respectively.

Although I haven't had chance to run a proper battery test on it yet, the fact the iPhone 6 can last much longer than a working day is a welcome relief in itself. Given another three years I'm sure I'll be cursing it as much as my old 4S, but right here, right now I'm absolutely smitten with the iPhone 6.

“ The consumer journalist in me wants to stand atop Mount Chuffed ”



Andrew Unsworth has been writing about technology for several years, he's handy with a spanner, and his handshaking skills are second to none

Hardware



Ryan Lambie has loved videogames since he first stared up in awe at a *Galaxian* arcade cabinet in his local chip shop. 28 years on, Ryan writes about gaming for Micro Mart. He's still addicted to chips and still useless at *Galaxian*

Over The Rainbow

Ubisoft's *Rainbow Six Siege* is a team-based shooter with a difference, with unique "operators" rather than traditional classes

This week, Ryan checks out Ubisoft's forthcoming *Rainbow Six* sequel, and looks at the startling growth of the free-to-play MOBA market...

Plug & Play

It must take a certain amount of resolve to cancel a game after three years and millions of dollars' worth of investment. That's exactly what Ubisoft did in June last year with its tactical shooter *Rainbow Six: Patriots*. Footage appeared in 2011 showing off Ubisoft Montreal's concept for a single-player shooter set in an American city besieged by terrorists. It looked solid enough, if not exactly genre redefining. Yet, by 2014 *Patriots* was dead and an new *Rainbow Six* sequel – suffixed *Siege* – had been ushered in as its replacement. The reason? According to Ubisoft boss Yves Guillemot, because the games industry's moving away from single-player shooters, so his company "needed to go first with multiplayer".

So it seems that, when *Siege* emerges later this year, it will be a multiplayer game first and foremost (albeit with a solo campaign strapped to the side). What we've seen so far looks a lot of fun – IGN put out some footage in April of a group of players breaching a clapboard house full of bad guys, and it had an air of tension missing from many modern shooters. In other

words, *Siege* appears to demand you be highly strategic about your entry points and routes through each mission. There's a palpable sense of dread in watching players lay thermite to blast a hole in a door and then peeking through to see whether there's someone with a gun waiting on the other side.

Elsewhere, Ubisoft's put out a video (youtu.be/qhOP0bTKj0o) which describes *Siege*'s new 'operator system'. Instead of the classes we typically see in team-based shooters, *Siege* will introduce 'operators', which are essentially individual characters with their own unique abilities – an idea taken from Tom Clancy's *Rainbow Six* novels.

"In the books," explains creative director Xavier Marquis, "Rainbow Six is a team built from the best special forces – it's a mix and match of different nations. That's exactly what we're doing, but we're raising the bar even higher."

Rainbow Six Siege looks highly promising. We just hope that, with the game's multiplayer focus, the single player campaign doesn't come off as an afterthought. As we mentioned, it's due out this year so we'll find out soon enough.

Online

As you've probably gathered by now, the free-to-play games sector is a big deal these days. Within the last five years, the revenue from F2P games has exploded from a shade under \$100m in 2010 to a projected \$1.2bn in 2015. This is according to research recently published on **GamesIndustry.biz**, which also revealed some more intriguing news – one aspect of the F2P market has accelerated far more quickly than the rest.

MMORPGs, which have for years dominated online gaming, are about to be superseded by the popularity of MOBA (Multiplayer Online Battle Arenas) like *DOTA 2* and *League Of Legends*. A glance at the data reveals that, while revenues from F2P MMORPGs has grown since 2010, its ascendancy has slowed over the past three years; the MOBA genre, meanwhile, has positively shot up – from a relatively niche area in 2012 to a market worth an estimated \$501m in 2015 – placing it just a shade in front of MMORPGs.

The new data, gathered by the market research company EEDAR, drills down further into the buying habits of MOBA



It's predicted that revenues from the free-to-play MOBA market will break the \$500 million mark in 2015, as Blizzard's Heroes Of The Storm joins the fray



players. According to their various graphs and pie charts, the overwhelming majority of players spend their money on cosmetic items – either for their avatars or other customisable items. Where 20% of players will spend their hard-earned cash on unlocking new characters, 46% will splash out on avatar cosmetics.

Players aren't necessarily spending huge fortunes on playing their MOBA games, either; on average, users spent just under \$25 on avatar cosmetics in 2014 – which, again, is the thing they most commonly spent their money on, just ahead of champion and hero unlocks, at around \$18. So while there's still a certain amount of resistance to F2P games from some quarters, EEDA's research shows that it's rapidly gaining ground. What's more, players don't appear to be spending their money on so-called 'play-to-win' aspects of these games, either; instead, they're buying things like costumes and new characters.

The findings also underline just how massive the MOBA genre has become. *League Of Legends* is currently king of the hill, with the game racking up a startling 67 million players

per month in 2014 – officially making it the most played game on the PC platform. As a result, we've seen other pretenders appear over the last year or two in an attempt to steal its thunder, including *Smite* and *Infinite Crisis*. Not to be outdone, Blizzard, a company which for years ruled the online roost, hopes to capture a share of the market with its own MOBA, *Heroes Of The Storm*.

Any game created by Blizzard is bound to make a splash, of course, and true to form, *Heroes Of The Storm* prompted a stampede when it entered close beta back in January – it was reported that more than nine million players signed up to join in. We'll have to wait and see whether *Heroes Of The Storm* has what it takes to beat *League Of Legends* at its own game, but whatever happens, it's clear that the MOBA genre will be around for many more years to come.

Incoming

The work of indie developer Acid Nerve, *Titan Souls* began as a stripped-down yet highly entertaining top-down action game. It boils down to a series of nail-biting boss battles spread across a retro-inspired 2D environment, where a single hit can send you packing off back to your original spawn point.

Now, Acid Nerve has created a more refined version of the game to tempt you into giving it a go, with improved character designs and animations – and a new comparison trailer (youtu.be/gXuhkDhzGjQ) to show you how much better it looks than the original. Beyond the undoubted cosmetic improvement, it's just as tough and addictive as it ever was; if you're looking at a challenge with the style of an old *Zelda* game and the brutality of *Super Meat Boy*, *Titan Souls* is well worth checking out.

All being well, *Titan Souls* will be available via Steam by the time you read this.



► It may look cute and retro, but *Titan Souls* is startlingly tough



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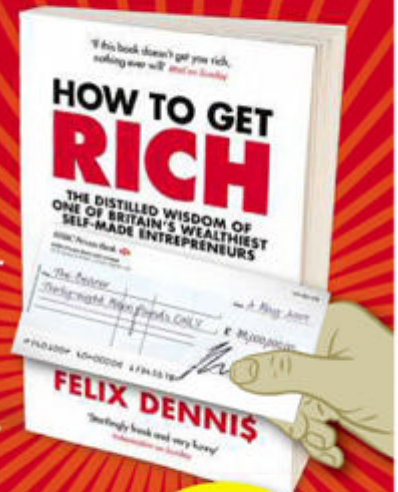
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Email: Johnhaviand73@gmail.com

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Email: Paul@planetvoodoo.co.uk

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- Be wary of anyone who insists on you paying by the above methods if in doubt, get us to check them out by mailing editorial@micromart.co.uk
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Please try to keep your queries brief and limit them to just one question per letter, simply so we can squeeze in as many as we can each week. Please include relevant technical information too.

Aaron

Flashback

Regarding updating the BIOS on my ASUS A88X-PRO, I have read the Motherboard manual (all else having failed), in which it describes a process called 'Flashback'. This involves downloading the new BIOS file from the ASUS website onto a USB flash drive (using another PC), inserting the drive into a specific socket on the motherboard backplane, and then pushing a button on the motherboard itself (with power on). This updates the BIOS directly, without needing CPU or RAM. Obviously I haven't tried it, much too scary, but somebody should; could be a life-saver (and money-saver). Other manufacturers may have a similar scheme.

Brian

Thanks for the mail, Brian. I must admit, Asus' Flashback technology isn't something I'm hugely familiar with, but it does seem to provide a BIOS flashgun function without the need to have an installed CPU. However, it's also limited to certain boards, and is an Asus-only function. From what I've seen on Asus' own site, the Flashback

function is currently limited to X99 and Rampage V Extreme boards. It doesn't appear to support any others. You also have to manually rename the BIOS files on the USB stick.

It's a very interesting feature, and if you have one of these boards, it could be a major lifesaver in certain situations. You can find more information at tinyurl.com/d7ulh3r.

▼ **Some Asus motherboard can be flashed without a CPU, but it's limited to a small range**



Clean Screen

This is probably a rudimentary question, but I wanted to ask for your advice on cleaning my PC monitor. I'm aware that I shouldn't just use any cleaner on it, due to the chemicals used, but I do need to clean it, and wondered what the best way to do so was. Please help.

Vic

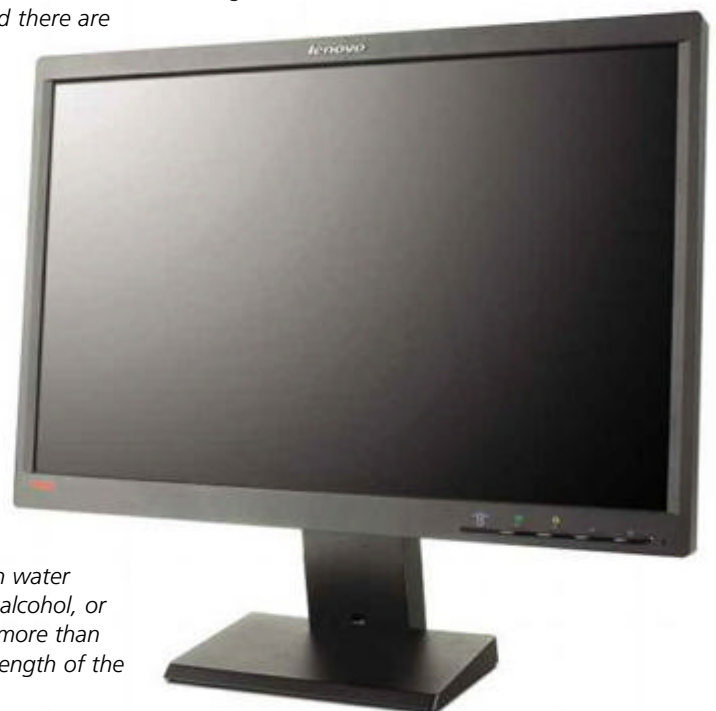
Don't apologise for asking any question Vic, as the saying goes: it's only easy if you know the answer. As for screen cleaning, it's a task that people do incorrectly all the time, and there are certain things you should do, and things to avoid.

You're right to avoid normal cleaners, as the chemicals used in them are often too strong, and potentially damaging to today's computer screens. Older CRT models weren't really a problem, due to the sturdy glass, but LCD screens are not so blessed.

The best method to clean a monitor is to always use a very soft, non-abrasive cloth. Microfibre or cotton cloths are fine, but try to avoid such things as kitchen towel, as the paper is too abrasive. For cleaning agent, it's usually best to buy special AV cleaning fluid, but some people make their own with water (distilled, not from the tap), isopropyl alcohol, or more simply, some white vinegar. No more than 50/50 for the alcohol, and test the strength of the vinegar option slowly.

Whichever solution you use, always power off the monitor (or laptop) first to avoid any potential issues. When cleaning, use the cloth in small circular motions, using very little, if any pressure. Too much pressure can damage the screen. When you're done with the cleaning solution, dry the monitor with a clean, dry cloth, and leave it for a while before using it.

▼ **Cleaning modern displays isn't difficult, but you do need to be careful, and avoid using the wrong type of cleaning solution**



You've Got The Touch

I've encountered a niggling problem with my laptop that I hope you can help with. I have an Asus laptop with Windows 8.1, and I always use a mouse with it, as I don't like the touchpad, and have no cause to use it most of the time. Previously I managed to disable the touchpad using options within Control Panel, and this prevented the touchpad from working at all. This meant that I could type and use the laptop keyboard without the chance of accidentally moving the pointer or clicking where I didn't intend.

However, recently this situation has changed, and now my touchpad has activated again, without input from me. To make matters worse, I can no longer turn it off, as I can't remember what I did before. It now causes me all sorts of problems, especially when using Word and browsing the Internet. Can you help?

Sol

Although I don't know what your model of laptop is specifically, or the method you used to disable the touchpad previously, I'd suspect you may have missed the easiest way to disable the touchpad (which is an

easy thing to do). Instead of playing around in Control Panel, or with your device drivers, all you should have to do is either press the touchpad toggle button, often located on the top-edge of the touchpad (although this can vary), or you can use your laptop's function key combination to perform the same task. For example, on an Asus laptop I own, the combination is Fn+F9, which turns off the touchpad (the picture below shows the key icon).



Not only is this an easy way to disable the input device, but it's also far more convenient a way to handle things – not least because you can then turn it one instantly again should you need to. This means if you're out and about, for example, you don't need to take the mouse with you.

▼ **Many laptops use a simple function key combination to disable the touchpad**

Best Backup?

I just read the story in your magazine regarding Paragon and Easus. I've never yet seen any mention of the best backup on the market, that being NTI Backup Now 5.5. I've used it for years, as I prefer to do backups to DVD where

I can do a rapid restore. Using NTI Backup Now, I can restore 40GB in 50 minutes or less, and I've seen no other backup software that can beat that, and I've tried them all. I just love NTI Backup now 5.5

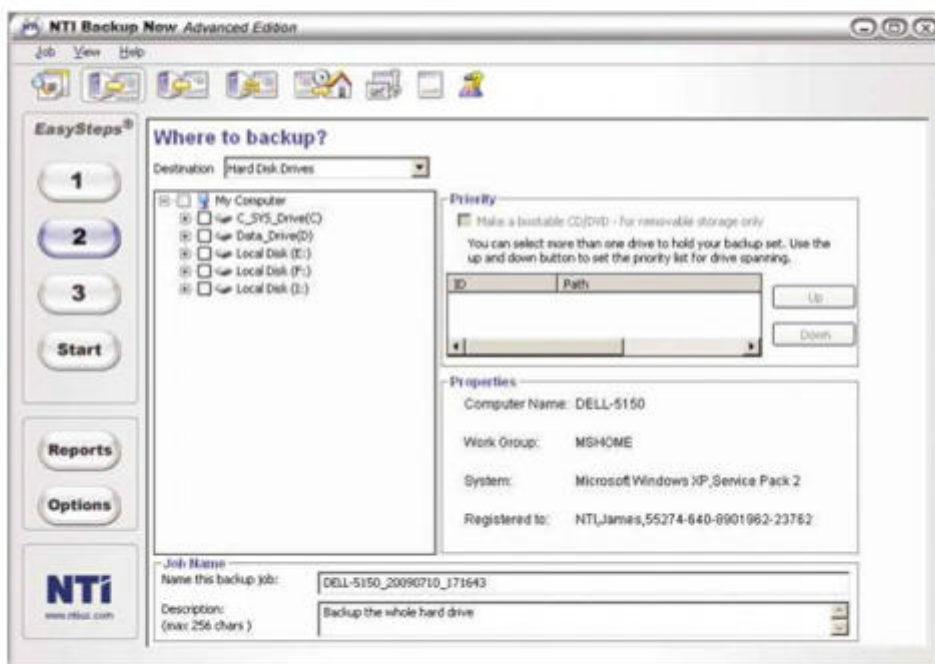
Jason

Although it's not one of the most well-known backup programs around, NTI Backup Now is a very good program, and whilst I wouldn't categorically state it's the 'best' option around, it's certainly well-suited for some uses. You clearly make the most of the software, that's for sure, and it's good to hear such a positive opinion of it; if you're convinced it's the best option for you them, quite simply, it probably is and you should keep using it.

The issue that we'd suggest stops many people trying out NTI Backup is that lack of a free version – which is why programs like Paragon are favoured by others, as it's a more accessible option. NTI has a trial, which is good for those looking for a new option they don't mind paying for, but if you're on a tight budget, free tools will always win out even if they are more fiddly to use or offer less. Paragon, however, does pretty much the same things for no charge.

However, I'd strongly recommend those looking for a powerful, and fast backup option check out NTI Backup Now; as Jason says, it's a very good application.

◀ **NTI Backup Now is a powerful, and fast backup solution, but it's not free**



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Jason

All About The Image

I'm a keen amateur photographer and on my blog page I often post photos I've taken. It was brought to my attention recently that at least two websites were using some of these photos for their own purposes. Now, I've visited sites in the past that have managed to disable right-clicking, making it impossible for content to be copied. How can I implement this on my blog?

Tim, BT

I've also visited such sites – let's skip over exactly why I've wanted to copy something – but I've not a clue how it's done. You'd be wasting your time, anyway. You see, if an image can be viewed, it can be copied. Even with right-clicking disabled, a visitor can simply hit Print Screen on the keyboard and grab a bitmap of the entire display (or Alt + Print Screen to grab just the active window). The result can then be pasted into an image editor and cropped as required.

The way forward, Tim, is to overlay your photos with watermarks. Put a faint but clearly visible copyright notice

diagonally across each one, or maybe your blog's web address. That will make the images virtually useless to anyone who wants to procure them without permission. My image editor of choice is the free Paint.NET – www.getpaint.net. And here's a quick tutorial on using it to add a watermark (it takes mere seconds): goo.gl/MSR9gG.*

** Copyright is granted automatically to the creator of any creative work (unless a contract dictates otherwise). There's no need to register it, contrary to popular wisdom.*

▼ *Adding a watermark is an effective way to minimise illicit use of images (even rubbish images of Europe)*



Wi-Fi Worries

I've got an old laptop, a Staples CP10V. It's running Windows XP, which I know is bad news these days, but Windows 7 isn't a prospect, not least because of the machine's 768MB of RAM (the most it'll take). I'm therefore planning to put Linux on it, probably Ubuntu. It'll be given to a friend and used for email, the web, and the like. There's no built-in wi-fi, but there is a Type II PCMCIA slot. What cards will work under Ubuntu with minimal configuration and messing about?

Anon., Lycos

Type II PCMCIA is better known now as Type II PC

Card. It's the same thing, but you might have more luck using the newer terminology when running searches. With Linux, the key is to ignore a component's brand and instead focus on its chipset or controller. It's this that needs to be supported. For a roster of wi-fi PC Cards compatible with Ubuntu (or not), point your browser at goo.gl/3xIRFz.

Few retailers stock PC Cards now, so your best bet is to scour eBay. New models tend to go for under a tenner, and used models can often be had for pennies. The list I've linked to has three columns detailing various types of support – ideally, you want a card or chipset that warrants 'Yes' across the board. Three

cherries on the win line. In truth, you can probably survive a 'No' at the start.

I can't find much about the CP10V. It seems it was a model sold under any number of different brands (not an uncommon phenomenon), but I've been unable to pin down the actual manufacturer and original product code. I'm assuming it has USB ports, though. You may well do better looking for a USB dongle rather than a PC Card. Again, use the list linked to above to find qualifying chipsets.

Please do note, though, my friend, that this laptop is clearly a museum piece. The 768MB memory limit is the giveaway. Modern Linux distros generally require at least 1GB, with 2GB

being more realistic. Ubuntu's specs are shown here: goo.gl/rBMNX3. I fear the CPU could also cause headaches – too old and too slow – and there may not be enough disk space. Even if you do get up and running, performance is likely to be woeful.

Perhaps Xubuntu could be a viable option (<http://xubuntu.org>), and there's also Linux Lite (www.linuxliteos.com). Both use Ubuntu as their base and are noted for working well on lower-order hardware. A common snag with these types of distro, though, is that they often have quite a steep learning curve. The user-friendly bits are what sap performance, so they're typically stripped back. You can read more about that, and a lot more besides, on this thread I've started for you on the Micro Mart forums: goo.gl/kSo8TY. I'm not much into Linux myself, but the folks replying there are.

► **Wondering which wi-fi cards will work under Ubuntu? Wonder no more!**

Model	Chipset	Driver	Supports network install?	Supported in installed system?	Works "out of the box"	Comments	Last Updated
F5D6050	?	?	?	Yes	Yes	Works out of the box on Feisty. Security not tested	2007-06-10
F5D9050(b)	Ralink RT2671F, RT2528L (RT73)	?	?	No	No	Full name: Wireless G+ MIMO USB Adapter. Chipset confirmed by Belkin.	2007-03-09
F5D7050 (v5000, USBID: 050d:705e)	Realtek RTL8187B	rtl8187b	Unknown	Yes	Yes	Until kernel 2.6.27-11, this was not natively supported. However, this device is now tagged with driver rtl8187. For a full tutorial see Belkin F5D7050 works natively in Intrepid	2009-01-16
F5D7050 (v5000)	Realtek RTL8187B	ndiswrapper	Unknown	No	No	No native support in 8.04. ndiswrapper works fine with the XP Windows drivers, however there seems to be an issue with the signal strength in that it seems to be lower than expected.	2008-07-23
F5D7050uk v4003 (USB ID 050d:705c)	zd1211	?	?	Yes	Yes	Works natively in 8.10 inc WPA2	2009-02-18
F5D7050 v4002 uk	?	No	Yes	Yes	Yes	Worked with GNOME Network Manager via WPA (TKIP) with Ubuntu 8.04	2009-07-15

Tablet Trouble

My Hudl's packed up! It won't charge. The USB port isn't damaged, and I've tried numerous chargers. Now the battery's drained, it's a paperweight. The devil of it is that this Hudl is my second – the first one developed the exact same fault about nine months ago and Tesco replaced it. This current one is now about six months old, so naturally I've got no warranty. Can it be fixed?

Luke, Leicestershire

The Hudl put a rocket up the UK tablet market when it launched in 2013. In terms of spec and performance, it fell between the original Nexus 7 (2012) and the new Nexus 7 (2013), yet at £119 it was significantly cheaper than either. Some feat, as the original Nexus 7 was a ground-breaker itself, offering Samsung-level hardware for half the dosh.

I recommended the Hudl wholeheartedly to friends, readers, and neighbours, and I stand by that. However, over time, it's become clear there are concerns over build-quality. A common issue is faulty touch-sensitivity. My girlfriend's device

suffered from this right out of the gate, as did her dad's.

Another common issue, as you know only too well, Luke, is failure of the charging circuitry. This happened to my girlfriend's device – the replacement for the first – after about eleven months, and the refurbished unit sent in exchange went the same way a fortnight after the warranty had expired. Sound familiar? I reckon the internals in the Hudl could well be held together with Sellotape, rubber bands, and Pritt Stick.

Tesco knows there are problems, and to its credit there's a repair programme in place, even for units now out of warranty. The number to call is 0800 323 4060 or 0330 123 4060 (the technical-support lines for electrical items). If you prefer, chat to an assistant in a live message session: goo.gl/jCIPz9. Have your order number to hand (this is usually eight letters long).

You won't get a refund nor, unfortunately, a Hudl 2, but you will get the item repaired or replaced (with a refurb). I recently went through this

Bits And PCs

This week I have been mostly...

...reading about the \$1.5bn fine Marvell's been handed for allegedly infringing patents held by the Carnegie Mellon University (it's 20% of the company's total worth – see goo.gl/35RnvC).

...playing *Captain Toad: Treasure Tracker* with my lad on the Wii U (if no extra levels are offered as DLC, and if baddie Wingo doesn't become a regular character in the Nintendo universe, I might have to complain to my MP).

...watching reruns of *Minder* on ITV4 (the stunt work is embarrassing, but, my word, no one writes scripts as good as these any more).

...listening to the Scottish female power trio that are The Amorettes (find them on Spotify if you fancy a bit of straight-ahead old-skool rock).

...building a gaming PC for the first time since *Minder* was prime-time (and what a belter it was – for the mere five minutes I got to play with it before handing it over to the customer).

process with my girlfriend's – she ended up on her fourth unit!

She'd already bought a Hudl 2 by this point – highly recommended once again, and I'm not aware of any build-quality problems – so I popped the repaired device on eBay and recouped £50. Fingers crossed it's still working...



◀ Tesco shifted good numbers of the Hudl (and the Hudl 2's following suit) – just a shame a fair percentage were warranty replacements

Crowdfunding Corner

Portable computing comes in many shapes and sizes, and so do crowdfunding projects. This week, we've picked two laptop-related ideas: one fun, one serious, but only through Kickstarter

Brik Case

If hipsters like one thing, it's Macbooks; if they like two things, it's probably Macbooks and Lego. Thus, it was only a matter of time, before someone combined the two – and the Brik Case is a Lego-compatible Macbook case that covers the lid in a sheet of Lego-style pegs so that you can customise it however you like.

It's clearly interested in putting the 'fun' into 'functional', but that doesn't mean that it's entirely pointless. Studies have shown that having toys on your desk can improve creativity and problem-solving, so there's at least a thin justification for buying this case, and if you need another, it's the price: at just \$35/£24 (RRP \$40/£27) it's inexpensive without being suspiciously cheap, and that price includes the case and 100 x one-square bricks inside a custom-made 'Bag o' bricks' to get you started on your decorative pixelated masterpiece.

The project's popularity is assured with over a thousand backers and double its target already met in half of the project's run time, so if you've got a post-2013 Macbook and a sackful of Lego going spare, your opportunity has finally arrived. Units are due to ship in August 2015, so start thinking up your designs now.

URL: kck.st/1GGrvVa

Funding Ends: Saturday, April 25th 2015

Remix Ultra-tablet

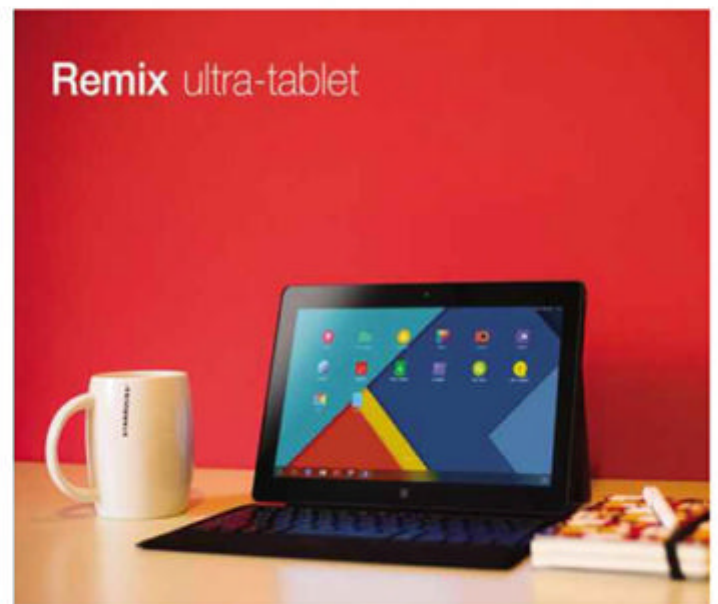
When it comes to mobile productivity, it's fair to say that Windows still has the edge over iOS and Android, simply because the OS is built for more involved usage. It doesn't have to be that way, though. Remix is a new OS/tablet combination based on Android 4.4.2 (soon to be updated to 5.0) that provides a mobile productivity environment for Android users who want a high-end tablet.

The 11.6" ultra-tablet hardware is designed with multi-window support and a taskbar for a Windows-like experience, and a full-size physical keyboard gives you all the comfort of a Windows laptop. The resolution is full HD (1920 x 1080) with 10-point touch, while the keyboard is 5mm thick and has a touchpad built in alongside magnetic connectors so that it can sit flush with the screen.

Again, the project has almost doubled its original target with half of the campaign still to run, and you can pick a Remix tablet up for the fairly reasonable price of \$349 (£235), which is less than an iPad Mini and only slightly more than most 7" tablets. Get in quick, though – they're only selling 700 units through Kickstarter, and at time of writing around 450 have already gone!

URL: kck.st/1ItTf1e

Funding Ends: Friday, April 24th 2015



Disclaimer: Images shown may be prototypes and Micro Mart does not formally endorse or guarantee any of the projects listed. Back them at your own risk!

App Of The Week

Microtrip

Ever wondered what it's like being a cell inside a body? Now's your chance

We've had a bit of a run of games recently, which isn't a bad thing, and before we get back to the more semi-serious side of mobile apps and PC programs we thought we'd just have one more. In fact, our decision taps into the spirit this week choice, *Microtrip* – a game that can get you hooked into a cycle of 'one more goes'. Created by Madpxl and Birslip, it's a pleasant little game where you control, either by tilting the device or via touch, a small, squishy cell as it travels through the insides of a strange creature.

The idea is simple enough, you have to keep your little cell alive by consuming white cells and avoiding the black, we presume

Features At A Glance

- Realistic soft-body physics
- Google Play leaderboards
- Two control schemes dependent on tech/taste: tilt or touch
- Awesome super bonus pills
- Procedurally generated levels

anti-bodies, which will damage you. All you need to do is keep travelling down, into the belly of the beast if you will, and progress through the levels.

It's Not As Easy As It Sounds...

The further you travel the harder the levels get, and the more obstacles you'll come across that unless you're careful will lead to an untimely death. The traps and diversions are many; some are just multiple pathway barriers, others are windmill-like and rotate – if your cell becomes captured by them, you'll be cast of in a different direction (hopefully toward more white cells and not the awaiting black ones that seem to congregate around such obstacles).

The physics in the game are wonderfully engineered. As you fall through the interior of the creature you're inhabiting you'll be squashed, you'll bounce and you'll be pulled and stretched, all the while you'll still have a smile on the face of your little cell. As all this happens, as it is with many of the best simple games, there's a natty little tune being played in the background.

Power-Ups

Along the way you'll come across a number of pills, which when collected will temporarily give you a power boost. The power boosts differ from pill to pill, and there's no way of telling which does what, so one minute you could have repulsing powers, and the next a white cell magnet.

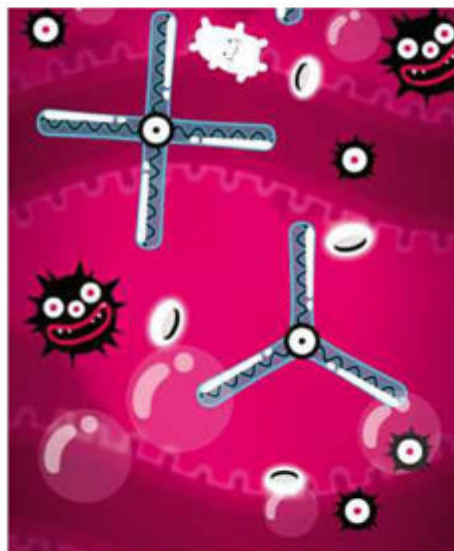
It all sounds very easy and simplistic, but once you get playing you'll soon realise just how devilishly difficult the game becomes after level one. Surviving to level three can bring on a sweat, and anything past that is the kind of non-blinking, hunched over the controls territory that was once only reserved for multi-player *Doom* with very little health left.

Conclusion

To conclude then, *Microtrip* is a delightful, well designed, and infuriating mobile game that's about as addictive as they come. It's free, and it comes with Google Play leaderboards too, if you're into that kind of thing. For us though, if we can get past level three we'll be happy. [mm](#)



▲ Keep the little fellow nourished by consuming white cells, which can't be good for the host body



▲ We're not up on our biology, but we're fairly sure stuff like this doesn't exist in our bodies



▲ Level Three is as far as we've got. How deep can you go?

Logging Off

Regular readers of Micro Mart will know that should a pretentious balloon be inflated, I won't be far away, sharp pin in hand. With that in mind I tuned into the launch of the high-definition music streaming service 'Tidal' and realised that money, power and adoration are no true substitute for intelligence.

For those unaware, Tidal is an 'artist owned' streaming service thought up by no less than Jay Z, and backed by his creative buddies like Madonna and Kanye West.

If you haven't seen the Tidal launch video, the term 'bizarre' doesn't really do it justice, because it's truly incomprehensible to anyone who hasn't sold millions of albums and never lived in LA.

It was like the weirdest science experiment, where someone had managed to extract the chemical formula for self-obsession and then inject it into famous people to parade their other worst personality traits. And then some of them started talking.

What they said went probably to the heart of why Tidal won't be worrying Spotify any time soon, because it was mostly delusional, mixed with a splash of pretentious. You see, Tidal is the streaming service for artists, by artists. Eh?

Right, so it's not for normal people, only those who are convinced that they're 'artists' then? Yet they're trying to flog this to anyone who will stump up the \$19.99 fee – twice what Spotify Premium costs in USA.

For that you get HD audio quality (which I couldn't distinguish from the normal compressed stuff), and some exclusive content provided by the shareholding artists.

Apparently, Jay Z has been hooking the other performers in by offering them 3% of equity, possibly unaware that you can only do this trick 33 times before the equity barrel is almost empty. It seems to this writer like one of those horrible selling-from-home schemes from the 80s, where you were encouraged to make money from your friends.

Basic maths problems aside, there were even rather disturbing elements to this, where those involved considered themselves the 'enlightened ones' and that Tidal was a force for some sort of global musical revolution. I suspect it really isn't.

What this has more to do with is the fact the artists aren't happy with the very small amount of money they get when their tracks are streamed by the various services, and they'd therefore like a bigger

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slice of the pie. Clearly, with an estimated net worth in 2014 of \$520m, Jay Z is concerned about any worldwide economic downturn and how he'll manage to heat his home(s) this coming winter.

Which begs the question: if they don't like the streaming deals, why agree to them? And if Tidal is the answer, why not make it an exclusive arrangement, where you can only stream Beyoncé or Alicia Keys on this service?

I'm all for performers (and writers) getting paid for their work, but a less-than-30 strong club of super-rich pushing an expensive service to make them even wealthier while calling it a 'mission' is just nausea inducing.

These people aren't connected to the life experience of the majority, who will take one look at Tidal and brand it as massively overpriced and egotistically swollen. The only good news is that Jay Z has already spent \$56m on the project, so that's some much needed wealth redistribution right there.

Mark Dickavance

LAST WEEK'S CROSSWORD

Across: 1 Expo, 3 Resolver, 9 Exurbia, 10 Clear, 11 Photorealism, 13 Abacus, 15 Mock-Up, 17 Intervocalic, 20 Solve, 21 Lip-Sync, 22 Narrower, 23 Clue.
Down: 1 Exemplar, 2 Pluto, 4 EBayer, 5 Oscilloscope, 6 Voetsek, 7 Rare, 8 Absolute Zero, 12 Epicycle, 14 Annular, 16 Evolve, 18 Loyal, 19 ISSN.

DISCLAIMER

The views expressed by contributors are not necessarily those of the publishers. Every care is taken to ensure that the contents of the magazine are accurate but the publishers cannot accept responsibility for errors. While reasonable care is taken when accepting advertisements, the publishers cannot accept any responsibility for any resulting unsatisfactory transactions. Anyone fancy a bit of politics? No, us neither, but with an election looming, we feel almost obliged to at least state some kind of opinion about it, especially seeing as our polling cards came through the door this week. Some of the MM team know exactly who they're going to vote for and why, while others are more unsure. Plus there are

at least one or two who didn't even know there was election going on and have never voted on anything other than *The X-Factor*. Of course, we'll all be affected by the result (of the election, not *The X-Factor*), whether we choose to vote or not, and then when whoever gets elected messes up the country even more than it's messed up now, those of us who didn't vote for the winners can sit back and gloat about how we're not to blame. Of course, there's always a risk your party of choice might win, in which case it'll all be your fault. You could vote Green or something equally unlikely to win, but if everyone get the same idea... well, then we're back at square one. Wow, this political stuff is more complicated than we thought.

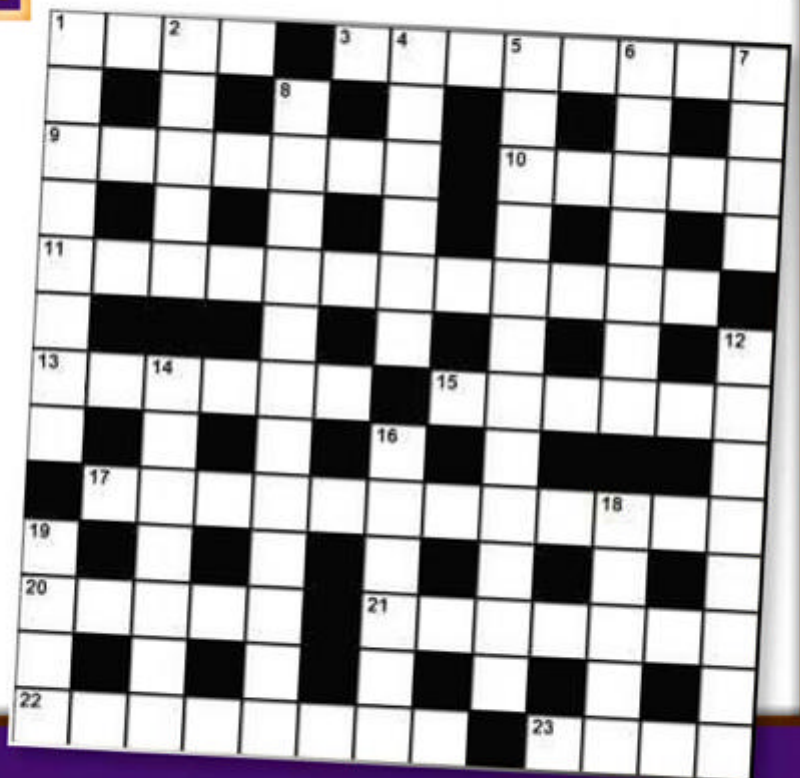
THIS WEEK'S CROSSWORD

Across

- 1 A group of nearly parallel lines of electromagnetic radiation. (4)
 3 Powerful free digital audio editor released under the GNU General Public Licence. (8)
 9 A substance or mixture for use in chemical analysis or other reactions. (7)
 10 A person who designs, writes and tests computer programs. (5)
 11 In Scottish slang, an affectionate term for a thin person. (12)
 13 Usually considered the last month of summer in the northern hemisphere. (6)
 15 British physicist who with Lise Meitner recognised that Otto Hahn had produced a new kind of nuclear reaction, which they named nuclear fission. (6)
 17 Chico, Harpo, Groucho and Zeppo. (4,8)
 20 A toy wind instrument, which has a membrane that makes a sound when you hum into the mouthpiece. (5)
 21 Of, relating to or constituting the entire period from the end of the Mesozoic to the present time. (7)
 22 Like or pertaining to Pegasus. (8)
 23 Used to express friendly feelings towards one's companions before drinking. (4)

Down

- 1 A light-hearted system of awards given to Wikipedia editors by other editors to acknowledge good work or other positive contributions to Wikipedia. (8)
 2 Founded in 1972, this company was a pioneer in arcade games, home videogame consoles and home computers. (5)
 4 A period during which a machine, especially a computer, is in operation. (6)
 5 The rate of change of velocity per unit of time. (12)
 6 Orders for goods to be exported or imported. (7)
 7 A unit of linear measure equal to 0.9144 metre. (4)
 8 In mathematics, a set of self-evident propositions from which the properties of the natural numbers may be deduced. (6,6)
 12 Relating to the sciences dealing with matter and energy. (8)
 14 In Wikipedia, the term for an edit war over which of several possible names should be used for a place. (7)
 16 .bn TLD. (6)
 18 Digital equivalent of a conventional book. (1-4)
 19 A Eurosceptic, right-wing, populist political party in the United Kingdom. (Acronym) (4)



The Things That Frustrate Us About... USB Connectors

The universal connector that's never the one you need: USB cables and devices drive us nuts

You know the routine: you go to plug your digital camera into your computer to transfer your photos over, and you have to first spend ten minutes finding the right cable, then an extra 30 seconds of faffing around to get the USB cable the right way to insert into the port on your computer. It's a minor irritant, yes, but it's an irritant – especially because you know you'll go through the same rigmarole next time you want to carry out the exact same task.

USB (Universal Serial Bus) is a type of connection between computers and devices, and it was meant to make things easier. And okay, by replacing the various other kinds of cables and connectors we used to have to use, it has. But it's also brought plenty of annoyances of its own. Here are some of the things that irritate us most when we plug in our many and various USB-connective devices:

Argh! Not Enough Ports

Your mouse probably connects via a USB port. Your keyboard might do too. So then that leaves one or maybe two USB ports, if you're really lucky, for attaching anything

else you might ever want to use, like a printer, a camera, your iPod or a USB drive. That means there's a lot of plugging and unplugging in your future.

Fix it: The easiest way to deal with this is to buy a USB hub; they're pretty cheap and can give you anywhere from four to 13 or more extra USB ports. The catch is that not all devices will be happy connecting to a hub, and if you're intending to charge your device, you'll probably have to plug it into the original port on your PC.

NRGH! Always The Wrong Way Up

It's a truth universally acknowledged that whichever way you try to insert a USB cable, it'll be the wrong way up. And somehow, sometimes it's also the wrong way up when you turn it upside down. It's infuriating but somehow USB cables are never as easy to plug in as they ought to be.

Fix it: Most cables have a USB symbol on one side, and that should be the side that faces upwards. Flash drives tend not to be so helpful, though, but 'up' should be the

side with the two open holes in it. So now you know.

Bah! Drive Needs To Be Formatted

USB flash drives are pretty handy for transferring data from one computer to another, like when you need to take some work home or give someone copies of photos or something. And most of the time they're very simple to use: you just plug them in and open the folder to get to the files. But sometimes you get that heart-stopping moment when your computer says the data on the USB drive can't be accessed and the device needs to be formatted, which could mean your data is lost forever. Ack.

Fix it: First, check the USB drive in another computer – and if it came from a Mac, try it in a Mac. If that doesn't work either, you might really have lost everything. These errors usually happen when the drive has been removed from a computer mid-transfer and data has been corrupted, so be careful if you've got important info you're moving around. **mm**



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